THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXV.—No. 11. Whole No. 419 | NEW YORK, SATURDAY, DECEMBER 2, 1876. | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

The *Journal of Gas-Lighting*, of London, is about to issue in monthly parts, this valuable treatise which has been appearing in its columns for some time past. It will be one of the most valuable compendiums of information on the past and present practice of the Science that has ever appeared. It will be liberally illustrated with plates and cuts, some of which alone will be well worth the price of the numbers containing them. We recommend every coal gas maker to subscribe for it. Subscriptions may be sent to this office, and the copies will be furnished as soon as they are ready. Full particulars as to price, &c., will be given as soon as possible. Each number will contain from 28 to 32 pages; and the pages are about 10 × 12 inches. They will be issued in paper covers, and can be bound to suit individual taste after all are received.

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ENRICHERS.

It is proposed to give our readers some results obtained by using Mr. Farmer's "Candle Feet" formula, in determining the relative values of different "enrichers," in the manufacture of gas from ordinary caking coal. The gas maker is constantly under pressure of one kind or another to adopt this or that kind of coal, or oil, or naphtha, in his works. Often his decision is made from a *general idea* that "there is no saving in it," or that "it is profitable," without having any well-established facts to base his opinion upon. Sometimes necessity forces the use of materials which are the best to be had, although it is known that others, if obtainable, would be better.

In this statement, for the purpose of a fair comparison, certain things must be assumed as a basis of calculation, as, for instance, the price of coal, naphtha, or petroleum, which, from its very nature, is a variable quantity; but, if our figures are right for one price, they can easily be adapted for different prices.

By enrichers we mean anything mixed with or added to the ordinary caking coals whereby the yield may be increased without lowering the quality and candle power of the gas. The most common enrichers, and the most generally available, are cannel coal, and either petroleum or some of its products. There are some minerals known as the Ritchie mineral, the Australian shale, and the "Albertite," which have great value as enrichers, but they are unfortunately scarce, and consequently high-priced. It is understood that the Boston Gas-Light Company now use what little "Albertite" there is, and have obtained some excellent results from it. The other two varieties are not in the market. The ordinary cannels in general use in the East are the Kanawha cannels, such as the Cannelton and Peytona. The most common caking coals are the Penn and the Westmoreland, and, using these as the basis, it is proposed to examine the relative value of the others as enrichers—for the purpose of making an 18 candle gas, with a yield of 4·66 cubic feet to the pound, or, in other words, to make a gas giving 84 candle feet.

Petroleum.—From the best experiments that have been made it has been found that petroleum will yield 70 cubic feet, of 70 candle gas, per gallon. In practice it is believed that the experimental results cannot be obtained invariably, or fully, on a long working, and that the value of the gallon of petroleum will not exceed 55 or 60 cubic feet of 70 candle gas; but, for the purpose of this paper, we will assume the experimental value to be correct. A gallon of petroleum weighs about 6·6 lbs., or 339·4 gallons=1 ton of oil—which, at 15 cents per gallon, would cost $50·85. One ton of oil yields (2240 × 70) ÷ 6·6 = 23,757 cubic feet of gas, or 10·6 cubic feet per lb., which would give us for the "candle feet" of petroleum—10·6 × 70=742.

Naphtha.—One gallon of naphtha will yield 60 cubic feet of 60 candle gas, weighs about 5·5 lbs., or 406·3 gallons=1 ton of naphtha which, at 10 cents, would cost $40·73. A ton of naphtha then would yield (2240 × 60) ÷ 5·5 = 24,436 cubic feet of gas=20·9 cubic feet per lb., and its candle feet would be 10·9 × 60=654.

Albertite.—This is a very rich mineral, and perhaps its full value is not yet determined, but owing to the fact that the supply is limited it is not of so general an interest as it otherwise might be. Experiment has shown that, for a yield of 15,000 feet per ton (6·69 feet to the lb.) it will give a 58 candle gas. This is believed to be a *low* estimate, but, nevertheless, this having been undoubtedly obtained; we take it on this basis which would give us for this enricher 388·02 candle feet. It costs about $23 per ton.

The Kanawha Cannels.—These are coals well known in this market, and their value is variously estimated; but we deem it perfectly fair to assume that they will give, upon a yield of 5 feet to the pound, a 40 candle gas.

We are aware that there is a difference in the value of the coals according to the kind, the method of marketing, and the exposure to which they are subjected, but for a general discussion the above value is taken, because it is known that they will give that in practical working when tolerably fresh-mined. So that for these cannels we have 200 candle feet.

Caking Coals.—For the basis of our mixture we take either the Penn or Westmoreland coal, which are very nearly identical in quality, and will ordinarily give 4·25 feet of 16 candle gas—hence the candle feet will be 68. From the above we have the following table of candle feet and price :

	Candle feet.	Price per ton.	Remarks.
Petroleum.....	742	$50.85	15c per gal.
Naphtha.....	654	40.70	10c per gal.
Albertite.....	388	23.00	
Kanawha cannels..	200	10.00	
Penn and Westmoreland.....	68	6.00	

For the purpose of determining the cost of materials for mixtures, let us assume the above values of condle feet and cost as correct,

1st. Taking a mixture of five per cent. of Albert and 95 per cent. of Penn, what will be the yield if 18 candle gas is made.

·95 × 68 =64·60 candle feet of Penn.
·05 × 388=19.40 " " " Albert.

84·00 candle feet of mixture.

Now, if this is 18 candle gas, from the definition of candle feet, we have a yield of 4·66 feet to the pound—as 84÷18=4.66+. If the yield was increased to 5 feet per pound, the candle power would be 84÷5=16·8 candles.

Let us now find what percentage of naphtha would have to be used to obtain the same amount of equal gas (*i. e.*, using Penn coal) how much naphtha must be used as enricher to give us a mixture of 84 candle feet=4·66 feet to the pound of 18 candle-gas—

Let x=per centage of naphtha, then
$(100-x)$= " " " caking coal
$654x$=candle ft. of per centage of naphtha
$(100-x)68$= " " " " of caking

from which we have the equation

$$\frac{654x+(100-x)68}{100}=84$$

As the sum of the candle feet of the parts of the mixture must equal the candle feet of the mixture which is to be 84—solving the equation, we have x=2·73=per centage of naphtha, and $(100-x)$= 97·27 per centage of Penn.

Proof—

654 × ·0273=66·143
68 × ·9927=17·854

83·997=84 candle ft. of mixture.

Having determined the relative amounts of the two enrichers necessary to produce the same gas, let us now see what is the relative cost of the materials.

1. *Penn and Albert.*

·05 ton of Albert @ $23=1·15
·95 " Penn @ 6=5·70

1·00 ton of mixture $6·85

The Albert yields 15,000 feet of gas per ton, and the Penn 9,520 feet.

·95 of 9,520=9,044 gas from Penn.
·05 of 15,000= 750 " Albert.

total yield of mixture 9,794

$\frac{6·85}{9794}$=69 9-10 cts cost per M Penn and naphtha mixture.

2. *Penn and Naphtha.*

·0273 tons of naphtha @ $40·70=$1·11
·9727 tons of Penn @ 6·00= 5·84

Cost of mixture.....$6·95

·0273 of 24,436= 667=gas from naphtha.
·9727 of 9,520=9,260= " " coal.

total yield of mixture 9927

$\frac{6·95}{9927}$=70 cts cost per M. of Penn & Albert mixture.

from which it would appear that the cost of the materials, for the gas made from the two mixtures, is about the same on the basis assumed.

By a similar course it will be found that 2·37 per cent. of petroleum, and 97·63 per cent. of caking coal, will give 84 candle feet. That the cost of the materials will be $7·06 per ton, the amount of gas made 9,857 feet, which will make the cost of materials for 1,000 feet equal 70.6 cts.

Using the Kanawha cannels, by the same kind of calculation, it will be found that the per centage of caunel necessary is equal to 12.12, and the percentage of caking coal 87·88 ; that the cost will be per ton, $6·48 , the yield 9,723 feet ; and the cost per thousand feet for the materials will be 66 2-3 cents.

TABLE OF MIXTURES GIVING 84 CANDLE FEET.

Enrichers	Per cent of enricher used.	Per cent. caking.	Cost per M ft. for material.
Petroleum*.....	2.37	97.63	70 6-10 cts.
Naphtha†.....	2.73	97.27	70 cents.
Albert.....	5.	95.	69 9-10 cts.
Cannels.....	12.12	87.88	66 2-3 cts.

* 15 cents per gallon.
† 10 cents per gallon.

The question of cost is considered only with reference to the purchase of the materials, not deducting for coke and other residuals. When oil is used the coke will be diminished not only by the amount that would be obtained by using coal but also by the amount used as fuel in distilling the oil.

It takes 7 1-2 bushels of coke to convert 42 gallons of oil, or 72 3-4 bushels for one ton of oil. One ton of coal can be carbonized by about 18 bushels of coke. We believe that this method of comparison is a correct one, and it certainly gives results that correspond very closely with actual workings.

THE METRIC SYSTEM.

The existing ideas upon this subject are so vague, that we propose to explain in as simple a way as possible, what it is. Any child can comprehend it, and as it is becoming more and more common in all scientific literature, it is to be hoped that more attention will be drawn to it, until it becomes the generally adopted system of the world.

As all are doubtless aware, the "metric system" is a decimal system of weights and measures.

It is better not to bother one's head about the equivalent values of the old denominations in first studying this subject, and when it is once understood by simply remembering in round numbers one or two values, it can be easily worked out.

The starting point is the "meter", which is equal to one ten millionth part of a quadrant (one quarter of a great circle of the earth), and is equal in length *to about* 40 inches. For expressing *divisions* or parts of the meter, the prefixes "deci", "centi" and "mili" are used, meaning respectively 1-10th, 1-100th and 1-1000th. For expressing *multiples* of the meter, the prefixes "deka", "hecto" and "kilo" are used signifying respectively 10, 100 and 1000. Hence we have

10 Mili-meters = 1 Centi-meter.
10 Centi-meters = 1 Deci-meter.
10 Deci-meters = 1 Meter.
10 Meters = 1 Deka-meter.
10 Deka-meters = 1 Hecto-meter.
10 Hecto-meters = 1 Kilo-meter.

This is the table of measures of length : for surfaces and cubes the same may be used by prefixing the term "square" or cube to the above, or sometimes the following terms are used.

1 Cent-are = 1 Square-meter.
1 Are = 100 square meters.
1 Hectare = 10,000 square meters.

Now, understanding the meter and its subdivisions, we come to the measures of capacity, which are derived directly from it, as follows—

If we construct a cubical vessel that shall just contain a cube, having each of its edges 1 Decimeter long, and fill it with water, this amount of water is called a "liter" (and is *about* equal to one quart) ; so that a "liter" which is used for both wet and dry measure is equal to a cubic decimeter, and divisions and multiples of it are expressed by the same prefixes as before, giving the following :

10 Mili-liters=1 centi-liter.
10 Centi-litres=1 deci-liter.
10 Deci-liters=1 liter.
10 Liters=1 deka-liter.
10 Deka-liters=1 hecto-liter.

The table of weights is derived directly from the former, as follows. Taking one "litre" of water, at 0° Centigrade, its weight is called a "Kilo-gram," or 1000 "Grams." Hence the gram is equal to the weight of one "mili-litre" of water, and, using the same prefixes as before, we have for table of weights the following :

10 Mili-grams=1 centigram.
10 Centi-grams=1 deci-gram.
10 Deci-grams=1 gram.
10 Grams=1 deka-gram,
10 Deka-grams=1 hecto-gram.
10 Hecto-grams=1 kilo-gram.

The kilo-gram is equal to about 2¼ lbs,

There is a rational simplicity in these relations between measures of length, capacity and weight, that it would seem should appeal at once to the practical American mind. Nothing could be simpler and less confusing ; and, if once understood, it would be used from choice. No one probably fails to remember how much easier it was to learn the table of Federal money than any other. No one finds any inconvenience in using the money (if he has it) in preference to sixpences, shillings, etc.

Errata.

In the Journal, Nov. 16th, on page 224, third column, third line, should read as follows :

About 16 pounds of sulphurretted hydrogen, and five pounds of carbonic acid, for every ton of coal carbonized,

Fourth Annual Meeting of the American Gas-Light Association.

NEW YORK, OCTOBER 18, 1876

[Continued from page 226.]

The Secretary—Mr. Goodwin has recently made some experiments with Crooke's radiometer, a new mode of measuring the quality of light; and if the Association would like to know about the working of this instrument he will now explain it to you.

CROOKE'S RADIOMETER.

Mr. Goodwin,—Mr. President and gentlemen of the American Gas-Light Association: I have been a member of the Association since its organization, and I believe I have never spoken at a meeting before. If there is any one virtue I have above another it is modesty. I feel very much embarassed at being called upon to explain an instrument that has heen so recently discovered as "Crooks's Radiometer." I acknowledge the compliment, but confess I do not feel competent to talk upon a subject that has occasioned so much discussion among scientific gentlemen at the present time; but, as you have called upon me, I will give you, in as few words as possible, the result of tests I have made with this instrument. I do not know, however, that the Radiometer is generally understood by the gentlemen present, therefore I will endeavor to explain it, and the occasion of its discovery, before giving you the result of my tests.

The principle on which the instrument works was the discovery of Prof. W. Crookes, of England. In a letter, giving a description of the instrument, and the discovery of the causes which led to the discovery of the mechanical action of light, as illustrated by the radiometer, he said:

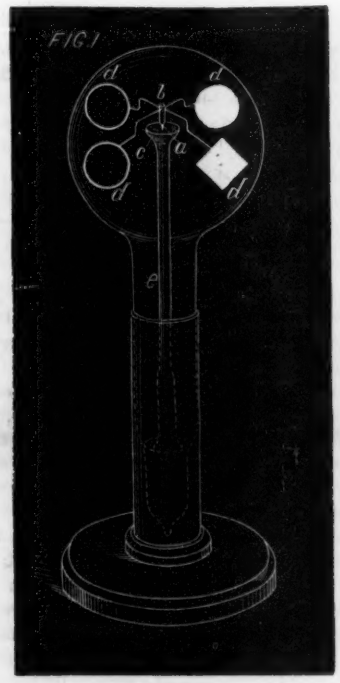
"It is well-known to scientific men that bodies appear to weigh less when they are hot than when they are cold"; the explanation given being that the ascending currents of hot air buoy up the body, so to speak. Wishing to get rid of this and other interfering actions of the air, during a research on the atomic weight of the metal thallium, he had a balance constructed in which he could weigh in a vacuum. He still found his apparatus less heavy when hot than when cold. The obvious explanations were evidently not the true ones. An unknown disturbing element was interfering, and the endeavor to find the clue to the apparent anomaly, led to the discovery of the mechanical action of light; thus, step by step, he was led on in his investigations which resulted in the production of the instrumcnt called the Radiometer."

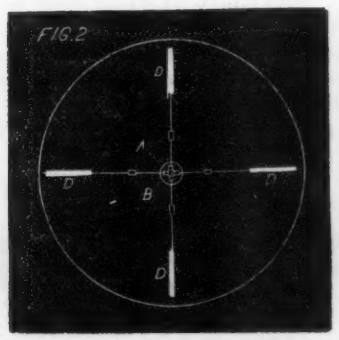
He states that he believes the results obtained are caused by the force or mechanical action of light, but certain gentlemen connected with the scientific world have questioned the correctness of his conclusions, some asserting the action to be occasioned by heat, others by electricity or other causes.

Whatever may be the reason for the action of the instrument, I thought I saw an element within it that might be applied to photometry. as already intimated by Prof. Crookes. I, therefore, commenced a series of experiments, or tests, and I will now attempt to give you the results of some of them, and leave you to draw your own conclusions as to the cause of the action of the instrument.

I will now proceed to illustrate the Radiometer by a drawing upon the blackboard before you (Mr. Goodwin illustrated the figure upon the blackboard.) We will suppose that you have two very delicate wires, probably two inches long, crossing each other at right angles; on the ends of these wires you place four discs, which are in a line with the wires. These discs are made of pith or mica, and are blackened on one side. From the centre, where the wires cross each other, there is a very fine needle-point or pivot, upon which the wires and discs rest, being balanced with great care. This pivot, or centre, rests in a cup of glass, so that the arms revolve horizontally. The glass cup is placed on top of a glass stem, and this stem is supported from the bottom of a glass tube, on the bottom of which is blown a glass globe, so arranged that the glass cup reaches into the globe, and the discs are suspended therein. This is placed on a stand. The air is exhausted from the globe, and as near a perfect vacuum is produced as possible.

You will please understand that one side of each of these discs is black, and the other side white, or the natural color of the mica





Let a represent the fine needle-point.

Let b represent the fine wires at right angles.

Let c represent the cap of glass.

Let d, d, d, d represent the discs of pith, or mica blackened on one side.

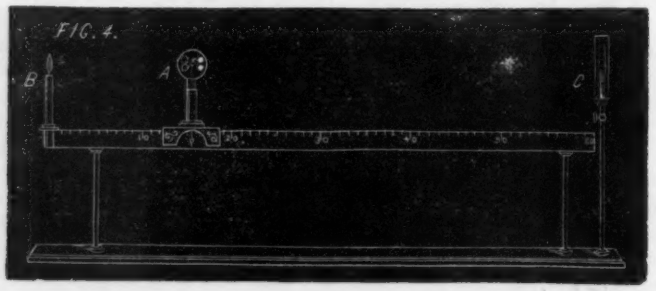
Let e represent the glass stem supporting the glass cup.

Now, if a ray of light from the sun, a candle, or match, or any other source, is brought within a reasonable distance of the instrument, the discs will at once begin to revolve. Take a match, for instance, and strike it, the moment the light falls upon the discs they will commence to revolve, for some reason; if you use two matches they will revolve twice as fast. If you use a standard sperm candle it will revolve at a certain rate of speed in a given time. If you place two candles at the same distance off it will revolve twice as rapidly, three candles three times as fast, and so on.

Mr. Crookes having come to the conclusion that the revolutions were produced by the force or mechanical action of light striking or impinging on the black sides of the discs, it occurred to him that it might be adapted to photometrical tests.

I will now give you the results of my tests. We will suppose that we have a 60-inch photometer bar, thus— (See illustration next page.) t this point, B, we will suppose that we place a candle, and at c an argand burner. When I first made a test of the instrument I did not take into consideration the *quantity* of sperm consumed. The test referred to was made with an argand burner consuming five cubic feet per hour, and I presumed the candle was consuming 120 grains sperm. Understand, I did not thoroughly test *that* question: therefore, leaving out the amount of sperm consumed, I found, by observation of my photometer, that the gas equalled sixteen (16) candles. The candle being 12 inches from the the sight-box disc, and the gas 48 inches from same, making 60 inches between centre of candle and gas burner. I then removed the sight-box from the carriage, and placed the Radiometer on the same, so that a line through its centre pointed to 16 candle on the bar. The centre of the Radiometer, by this arrangement, occupied the same position as the sight-box disc, which is represented in the drawing by A. I then, by means of a stop watch, observed the time necessary to obtain one revolution of the discs of the Radiometer which equalled 30 seconds. Now, it is a law of the instrument, or of the theory, or whatever you choose to call it, that if you place a candle anywhere on the periphery of a circle, in which the centre is represented by the Radiometer, assuming you get one revolutior in thirty seconds, if you place a second candle anywhere on the periphery, you will get double the light and double the number of revolutions in the same time. Following out this theory, I concluded that as the gas burner, at 48 inches from its centre, was giving a light equal to one candle at that distance from the instrument, if I relit it the result should be the same as two candles on the periphery of a circle whose radius equalled 12 inches—the distance from instrument to candle. Upon lighting the gas I got two revolutions in 30 seconds, as I anticipated, which proved the lights were equal I then moved my carriage towards the gas, so that the distance between the centre of gas and Radiometer equalled 12 inches, and I got 16 revolutions in 30 seconds. I will leave you to draw your own conclusions as to whether heat, light, or electricity produced the result. (Applause).

If I can give the gentlemen of the Association any further information upon the subject I shall be glad to do so.



Mr. Starr—I would like to enquire whether the instrument you have now is different from that of Mr. Terry?

Mr. Goodwin—It is the same. I will try to explain the instrument a little more in detail if I can. It is a glass globe, about two inches and a-half in diameter. It is supported by a glass tube which is a part of the globe, and which is about an inch in diameter, running down say the length of four inches, or thereabouts; from the bottom of this tube there runs up a glass stem into the globe, with a small cup of glass upon the top. On this cap are placed the revolving wires supporting the discs—the light striking the blackened surface, the discs immediately commence to revolve. You will understand the globe is exhausted—almost a perfect vacuum being produced.

Mr. Starr—Why is one of these discs made square and the others round?

Mr. Goodwin—When Mr. Hicks was in this country I suggested to him that, if one of the discs had a mark upon it, the revolutions could be counted much more readily. The discs of the one I had at that time were all round.

Mr. Neal—You say you tested it with candles?

Mr. Goodwin—Yes; I made several tests with it, and it occurred to me to alter the shape of the discs, which I suggested to Mr. Hicks, which resulted in the adoption of the diamond shape at his suggestion—and in ordering a lot of the instruments, that form was agreed upon. It does not make any difference about the shape, so the instrument is in equilibrium or balance.

Mr. Neal—Have you got one of those instruments here?

Mr. Goodwin—No, Sir; I have not.

Capt. Dresser—The instrument can be got on Union Square. I will try and get one and bring it here to-morrow.

Mr. Littlehales—Is it in order, Mr. President, to move a vote of thanks to Mr. Goodwin for this explanation?

The President—It is always in order to do anything that is polite.

Mr. Littlehales—I move you then, Mr. President, that a vote of thanks be presented to Mr. Goodwin for his explanation of this instrument. It seems to me that it may be a very valuable thing to us by and by, and if he can give us anything that will lead us to more accurate results in photometry, it will certainly be of great advantage to us. It seems to me that this is a very important discovery. At least it is a very interesting one, and it may lead to results in the future that will be of great benefit to us.

The President then announced that the reading of papers was still in order.

The Secretary stated that Mr. C. H. Nettleton had a paper upon "Burning Breeze under Boilers."

Mr. C. H. Nettleton—Gentlemen of the Association you will, no doubt, think it very bold of me to come before you, and present a paper; but I have attended nearly every meeting of this Association, and have hitherto had nothing to say. The question of burning breeze has been considerably agitated, and as I have made a few experiments in that line, and have given the subject considerable observation and study, I thought that it might not prove uninteresting to you to prepare a paper showing the results of my experience. I know of only two works in the country where breeze is burned under boilers, and if I take the liberty of detaining you on a subject about which you may all be familiar, I trust you will pardon me.

Mr. Nettleton then read the paper, as follows:

BURNING BREEZE UNDER STEAM BOILERS.

It is with much diffidence that I come before you to read a paper on the subject of "Burning Breeze under Steam Boilers," both because the subject is hardly worthy of such dignity, unless accompanied with a series of scientific data, which I am unable to give, and also because it is not a gas subject, *per se*, but only as a side issue; but as it has been the cause of saving some money for the company I represent, I propose to tell you of it, and you must judge of its value.

To burn breeze under a boiler, four things are necessary—a grate of somewhat different pattern from those in ordinary use, a blower, a conducting tube between the two, and motive power.

The grate is the only one of the four needing any description. To make the pattern for it, a smooth plank, of about one inch in thickness, is cut to the form of one half the grate if round, or, if square, of such dimensions as to be easily handled when cast, and of $\frac{1}{3}$, $\frac{1}{4}$, or one-fifth of its full size. Then, by two series of parallel lines at right angles, the plank is divided with squares of about one inch. At the corners of each square one-quarter inch holes are bored through the plank. These holes are enlarged on one side to about one-half an inch diameter, and taper to the original size on the other side, giving each the shape of a frustrum of a cone. By burning these holes with a hot iron to smooth them, the pattern is ready for use, and where it is well made there should be no difficulty in obtaining castings at four to four and a-half cents per pound. Where the grate is large girders one inch in thickness, and of any depth required, can be cast on the under side, and form a part of the grate.

In the matter of the blower, I prefer the slow motion positive blower to the fast-running centrifugal ones in ordinary use. The slower the machinery can run the longer it will last; and, besides, there is very a great difference in the cost of fitting up for the two. Most of us have slow-motion exhausters, with a line of shafting running at not more than 150 revolutions, and often not over 100. To get from this up to 2,000 to 2,500 revolutions, as is necessary with the fan blower, two good sized pulleys, and a countershaft have to be used. With the positive blower very little is necessary. In my own case I put a twelve inch pulley on the shaft, and bolted direct to the blower. The tube any tinsmith can make, only it should be sufficiently large to prevent friction as much as possible in the passage of the air to the boiler. It connects with the boiler at any point under the grate. I have the tube coming up through the ground in one corner of the square iron base which supports the boiler, and running up about six inches from the ground, so as to prevent the ashes from falling in.

When ready for use the grate is placed in position, with the small end of the holes on top, a fire is commenced with red-hot coke or wood; after the engine, and with it the blower, are started, then the breeze is thrown in. Care must be taken to have the breeze of equal depth throughout, otherwise, the air finding a thin spot, will rush through at that point, and the result will be a lively fire in one place, and a dead one elsewhere.

The cost of the whole, including pattern, was in my case, $50 for a four horse boiler. I find that where I formerly used nine bushels of coke weighing about 360 lbs., to do the same work, required seven bushels of breeze, weighing about 350 lbs., so that, pound for pound, the fuel is very nearly equal, With me breeze sells in the yard at four cents per bushel, and coke at 12½ cents, so that, by using breeze, I accomplish with 28 cents, what formerly cost me $1.12½.

It is but fair to state that the idea is not original with me. In the town in which I reside a machine shop has been run for years, by a boiler heated as I have described, with the refuse coal screenings from the coal yards for fuel. And here permit me to suggest that coal screenings are just as easily burnt as breeze, and with a good many of you the coal dealers in your towns will be glad to have their screenings carted away, so that in such cases the cost of fuel for a boiler would be merely nominal,

I should not have brought this matter to your attention, but I firmly believe that the success of gas companies in these hard times, depends in large measure on practicing such economies. It will save for my company, in one year, about $300, and while, to a large concern, $300 may seem small, yet to small companies, a few such savings help a long way on dividends.

CHAS. H. NETTLETON,
Eng., Derby Connecticut.

Mr. Harbison—How often did you have to renew your breeze? What depth did you put in?

Mr. Nettleton—I should say perhaps once an hour. I only put in a thin coat, not more than an inch in depth.

Mr. Harbison—I would like to inquire if, in using this breeze, you had any trouble in putting it in?

Mr. Nettleton—I had no trouble at all.

Mr. Harbison—What blower did you use?

Mr. Nettleton—I used one of those large-sized blowers that you have seen in a blaksmith shop—a large-sized blacksmith's blower.

Mr. Harbison—What furnishes the power?

Mr. Nettleton—The engine.

Mr. Harbison—The engine that runs the exhauster?

Mr. Nettleton—Yes.

Mr. Starr—I would like to inquire of the gentlemen what breeze is? Where do you get it?

Mr. Nettleton—It is the refuse screenings from the coke pile.

Mr. Star.—What is the size of the largest pieces of coke you have in it?

Mr. Nettleton—Here are a few lumps. I do not screen it at all. I use the coke refuse in front of my retorts. It makes no difference in regard to the size. I can use the finest dust as easily as I can the lumps, and *vice versa*. If I had any sale for small lumps, I should screen it.

Mr. Starr.—I am not a profound scientific gas man, but I have always understood that breeze was a portion of that, which comes from under the retorts I use the stuff that comes from under the retorts, and shovel it right up out of the ash pan, clinkers and all, and on that I throw my breeze, and I make all my steam, and crush my coke for nothing. I used to get an excellent fuel out of this pile of ashes, and clinkers, and fine dust, but latterly I have got to using the stuff from out of the ash pan. I screen it through a one-fourth inch or a three-eighth mesh. That takes out several of the lumps of tar that will drop out of the retort, and the lumps of coal that will come through the grate bars and the lumps of coke, and that, with my fine breeze, make me an excellent fuel. I use no blowers. I fire on one side of the boiler at a time. I throw in a pile of this rough material on one side, and when that is heated and burning, and the other side is burned down. I fire on that side; and I use it in this way with great success. I sell my crushed coke in our town. I have an apparatus righ

by my door where I wet it. It takes the place of anthracite coal with us. As I have stated before, in the small town where I live, I have sold from our works 46,000 bushels of what we call pressed coke. The breeze or fine dust I screen, and mix with a little bit of Youghiegheny coal, and sell it for four cents to a machine shop there. If it was not for the machine shop, I should have no market for it. There was a time when the screenings were given away for the cartage, but now we charge $3 per ton.

Mr. Harbison—I would like to make one or two remarks in reference to coke. It is very important to prepare coke in two ways; or, rather, it is very important for us to make good coke, and, in the second place, it is a very good thing to have it have a good reputation. Mr. White has suggested an idea about getting red of his coke, which I think is a very poor one. He says that they give it to the poor. I think that is a very poor plan. He had better sell the coke for what he can get, and then give the money to the poor; because, by giving the coke to the poor, he gave it a bad reputation as fuel. You cannot get the better class of people to use it.

Mr. Starr—I used to have a large trade with New Foundland. You all know that the government distributes among the poor yellow corn meal. We all know that yellow corn makes a much better meal than the white corn does. We used to ship thousands of bushels of yellow corn to New Foundland, but after the New Foundland government began to distribute the yellow corn meal to the poor we never could get the better class of people to use it; simply because the poor people used it. You have got to make coke which is a good fuel, acceptable to the better class of people, or it will not find a market.

DEPRECIATION IN PLANT.

Mr. Pearson (Toronto)—Our company has had some difficulty lately, in knowing exactly how much to take off on annual deprecation in plant. I should like to have the opinion of some gentleman of experience here, as to how long, on an average, street mains last. In regard to my own experience, we have had in Toronto, street mains which had been put down for 30 years, and when they were taken up they were found to be as good as when they were first put down. In some parts of the city there is clay soil, and in other parts sand. I have concluded that it is owing a good deal to the nature of the soil through which the pipes pass. In some cases, where streets have been filled up, particularly with ashes and other material, we have found the pipes have corroded in the course of a very few years. This is a very important matter to gas companies, or it would be to ours, at all events, to know how long such materials, on an average, will last. It would also be of great value to have accurate information upon this point, in order to know how much to take off as a proper amount for depreciation. I ask this question in order that I may have the benefit of the experience of members of this Association that are well informed upon the subject. There is a gentleman present who mentioned to me to-day, that, in the city where he resides, they had erected a gas-holder in 1838, which in 1872 they took out and sold again, and found the iron to be about as good as when it was erected. He perhaps has some further experience upon that point, and it may be useful to the members of the Association. The gentleman I allude to is Mr. Rankin, of Louisville.

Mr. Rankin.—The experience alluded to by Mr. Pearson from Toronto, is simply in regard to the gas-holders in our works. When our works were built, during the year 1838, we had two gas-holders erected, 40 feet in diameter and 18 feet in depth, containing about 18000 cubic feet each. These holders were used every day, from the time our city was first lighted with gas, until they were taken down in 1872. We tore down the old holders, and the iron, so far as we could judge from its appearance, was just as good as it was the day the holders were constructed. The iron is still being used for such purposes as we find it convenient to use such iron for. The other holder was sold to a gentleman, who was engaged in the erection of small gas-works, and he took the holder and a portion of the frame-work. That suited his purpose. The iron was used in some town in the interior of Indiana, the name of which I cannot now give you. The holder was reconstructed, and it is being used to-day. Several parties here seen this holder, and the gentleman assures me that the iron on the holder since it has been reconstructed, was better than any iron he can procure at the present time. I dont wish the gentlemen to understand me to mean, that the old iron, from the holder is of better quality than iron which can be procured now, but I mean to say, that the original quality of the iron was better than iron which can be procured now for such purposes. The gentleman has inquired in regard to the duration of street mains. I have no information which would be of any service to any member of the Association. As to service pipes, I might say something in regard to our experience about them. I come from the city of Louisville, where we have a lime stone under-formation, with clay and sand. The clay is on the top; a few feet below that we have the sand. We have service pipes in our city to-day, that were laid down in 1839 We very frequently have occasion to take some of them up. So here we have taken them up, and had occasion to renew the pipe; we frequently find the old pipes in a perfectly good condition. In other parts of our city we have sand, when the clay has been removed, and we find in such locations the pipes entirely gone, so far as the iron is concerned. We find a very large mass of clay mixture, clay and sand, and the iron very good to all appearances, until it is disturbed. We find in other places, where we have laid down service pipes within the last eight or ten years, that they have great holes eaten in them; I presume that it is the experience, however, of every gas man. It is, so far as I have had an opportunity to talk with them, upon this subject. While I am up I would like to say, if there is any gentleman here that would like to talk upon the subject of naphthaline, after we have concluded our meeting here to-day or at any other time, I should be very glad to have a conversation with him. We are troubled a great deal with it, but I cannot make any suggestions at the present time, in regard to it, that would be of any value to the Association. I would however, be glad to have the views of any gentleman upon this subject, who has had experience.

The President—I am told that Mr. Price has prepared a paper upon the subject of "Street Mains."

Mr. Price—I have, sir

The President—We would be very much pleased to hear it now.

Mr. Rankin—I would make one other statement in regard to gas-holders. It has been my custom in the construction of gas-holders, to require the contractor to give them three coats of red lead and boiled oil: one coat as soon as he has framed and punched the iron, another coat after being removed from the shop to the premises, and then requiring him to give them a final coat inside and out. Our aim is to protect the iron and prevent oxidation. After we have done that our holder takes care of itself.

Mr. Neal—I don't wish to interfere with the reading of the paper by Mr. Price, but this subject has suggested some considerations to me, and I would like to ask a question before Mr. Price reads his paper on "Street Mains." Our street mains have lasted, some of them, for twenty-six years, and generally speaking, the complaint of gas works in regard to mains might be avoided, if they were kept in order. My rule is to keep everything in proper repair. It very often happens, on taking up the mains for some purpose or other, people will go by and see the crust of soil or earth that has formed upon the pipe, and they will say that it is corroded and rotten. I tell them to just scrape off the clay and they will find a good body of iron beneath; just as good as it ever was. In parts of the district of Charlestown where pipes are laid, they are subject to the action of salt water, not perhaps directly but indirectly. The ground is saturated below the pipes with salt. At this moment the city is grading certain sections of Charlestown, and I have my gang of men go before and examine every one of the pipes. Some of the service pipes we find as thin as paper. They are only kept tight by the covering of soil or clay. I have enquired a great many times in order to try and find out if there is any remedy for this. The gas will pass along through them of course, and the pipes will seem to be tight as long as they are not disturbed. If they don't leak they give a great deal of trouble to the consumers, because they fill up with the soil that works in, and that makes a good deal of trouble. I should like to know of any gentleman here, whether there is any material that can be used upon service pipes that will resist the action of the salt.

Mr. Cathels—I should like to say a few words in regard to the manner of laying service pipes in London. It has been adopted for many years there, and it has proved very successful. Instead of laying them on the ground as they do here, they construct a V shaped wooden trough made of boards, and in the bottom of the trough they put a preparation of asphalt or pitch and sand, and they lay the pipes in this V shaped trough, and fill the trough up to the top with the preparation. In that manner the pipes are encased in a preparation that is impervious to the action of water or of salt, and it forms a coating about the pipe, so that it is impossible for anything of that kind to penetrate. It effectually prevents water from coming in. Galvanized iron has been used in the works of which I now have charge, and has been there ever since the works were started. Galvanized iron pipes are certainly a very great improvement upon the plain black pipe. In regard to rubber coating on pipes I have no experience of that. There is one other thing which I would like to mention, which I think is of some importance, in regard to laying service pipes. I don't know whether it is the custom now, but it has been the custom previously to tap the main on the top, instead of tapping it on the side; that has several objections. In the first place, when the pipe is screwed into the main, and then bent around in the shape of a quarter of a circle, it is liable to be drawn back and become loosened from the main. Then, again, it has a tendency to promote the accumulation of naphthaline. We know that to guard against naphthaline one of the conditions is, that the pipe shall lead straight into the main, with as great a fall as possible, so as to prevent any accumulation of moisture in the pipes. We frequently find a coating of hoar frost where the service pipes enter the main. Tapping the main in the side certainly has a great many advantages, and it only requires a little more excavation. It is, in my judgment, much the wisest plan.

Mr. Littlehales—I would like to say a few words in reference to laying service pipes. We have been renewing a good many during the past few years, and I have found that we have the worst ones where the soil contains iron. It acts as a strong acid and eats into them very rapidly. I have found pipes on several occasions that have not been laid down more than three years, completely destroyed. In taking up some old mains, about twelve months ago, that had been laid some twenty-six years, we found red lead and white lead marks made on them, at the time they were shipped from Glasgow. The words "H. G. & Co." were just as perfect as they were when the pipes were made. The lead had been a perfect protection, while the part surrounding it was corroded; and I am of the opinion that red lead and white lead are the most effective preservatives we have. We have laid a great many thousand feet of service pipe, and we generally heat them and then coat them with tar. We generally give them two coats, and put it on as thick as possible. The great thing is to keep moisture from them. If you can keep them from getting damp, of course oxidation will be prevented. So far as the inside of the pipe is concerned, I think that a coat of either red or white lead will be about the most effective preservative you can have. We have a great many thousand feet of the tar coated pipes. I have examined pipes that have been laid about twelve months without the coating, and I have examined

others that were coated with the tar and laid about the same time, and I have found that the uncoated ones, in several instances, were eaten badly in some places, and the tar-coated ones were just as perfect as when they were laid.

Mr. Starr—At what point do you find them giving away?

Mr. Littlehales—The whole length of the pipe.

The Association then adjourned until to-morrow, at 10 A. M.

SECOND DAY.

THURSDAY, OCTOBER 19, 1876.

The Association met pursuant to adjournment, at 10 A. M., and was called to order by the President.

The President—Mr. Price, we are ready to hear your paper now, if it is agreeable to you.

Mr. Price—I present what I have written with a great deal of diffidence. In the first place it does not seem to me to be a subject that permits of a very great amount of intellectual effort. But I have endeavored to embody simply one method of doing this particular thing of laying the pipes, and while I think it is of a great deal of importance to the managers of gas works, yet, as I said before, it does not seem to me to be a topic of sufficient importance to justify the writing of a paper. I have written in great haste, and perhaps without much regard to style or grammar.

Mr. Price then read the paper, as follows:

ON STREET MAINS.

Perhaps no department of the complete outfit of a gas company is deserving of more wise and careful attention than that of distribution. Having secured a good field of operations, a good site for the manufacturing and storage of his gas, and having constructed his works and his holders upon the most approved plan for producing a good article, at the lowest possible cost, and properly storing the same, an adequate and well laid net work of pipes for conducting the gas to every part of his district, is of prime importance to the gas engineer. Every other department may be perfect, but if this is defective, his labors will be thwarted, and his capital will be unproductive. In compliance with a request which I could not disregard, I shall proceed to offer a few practical suggestions relative to this important topic; and in doing so I beg that I may not be regarded as presuming to teach, but as merely endeavoring to state the views which have been impressed upon my own mind, by the experience of a few years, in the management of the interests committed to my care.

In determining the several points involved in a suitable system of distribution for a given town, the first thing to be considered is, *the size of the mains proper to be laid.* The general rule to be carefully observed is this, viz., *liberality in the capacity of the mains.* Let the pipes be of such size that the volume of gas required shall have free course, and go forward without hindrance. By all means use such sizes of pipe that there shall be no necessity for heavy pressure, in order to give your customers a supply of gas; for excessive pressure is attended with many evils.

1st. By it leakage will be much increased, and

2nd. The bills of consumers will be made so large, as to cause complaints and withdrawals. "By doubling the amount of pressure, the consumption of gas will be increased about one half."

If the engineer make a mistake here the evil will be serious, I will illustrate by a case that came within my own observation. A certain gas company had pursued a narrow policy in the matter under consideration, and had laid much small pipe in the days of its poverty—some even as small as two-inch—and when the city where it is located, about thirteen years ago, began to grow afresh, and for ten years expanded and filled up with marvellous rapidity, the gas company I refer to was pressed on all hands to extend its mains, so as to keep pace with the demand for more light, miles on miles were laid, but the chief distributing lines were neglected, and remained for years too small. They answered very well in the season when but little gas was required; they were summer sizes. When autumn and winter came, and the demand for gas became large, then a supply for remote districts could be furnished only by the application of heavy pressure, and this effect followed. The business portion of the town, near where the works were located, had excessive pressure and too much gas, while distant streets had too low pressure and too little gas. All the near by and largest consumers raised a great outcry, because their bills were suddenly nearly, or quite doubled, and the more remote consumers sent in a loud cry for more light. As times became hard and economy necessary, the evil grew to be serious and resulted in an oil war. Hundreds abandoned gas and took in petroleum; in some cases because it was cheaper, and in others because they were angry with the gas company and wished to punish it. And it did suffer severely in consequence of the error I have described. It should be borne in mind that as winter approaches, gas bills inevitably become large, even under the most perfect system of distribution; and hence it is clearly a great error to either lay or perpetuate a net work of mains so small, that the bills of consumers are made excessively large, at the time when they are naturally large enough for the comfort of those who collect them, thus needlessly increasing the storm, usually sufficiently unpleasant with the best system of distribution that skill and money can provide.

As to what sizes of pipe may be suitable in any given case; it is obviously impossible to speak definately. In determining this question everything must be considered—present needs and probable growth. In any case I would never lay a foot of two inch, and but little three, even for cross connections. It costs nearly as much to lay a three as a four inch pipe, The digging is the same, and so of nearly all the labor. The joints cost a trifle more, if lead be used; of course there is more iron in a foot of four than in a foot of three inch, but in these days of cheap iron, the whole expense of the former is but a trifle, while the capacity of a four is nearly double that of a three inch. These remarks will apply to the larger sizes, in a general way, that is to say—if there is a likelihood of needing a large pipe in a given street, it is generally better economy to lay it at first, than to put down a smaller one, which must be removed ere long.

There have been attempts to improve upon the old fashioned pipes, but I am not aware that anything is better than plain, old style shapes, cast vertically, with the socket end down to avoid shot holes. A good quality of foundry iron should be used, so that the pipe may be tapped with a clean nice thread, and without too much expense of labor. If the pipe is made of too hard iron it will be hard to tap. Sometimes the pipe will crack in tapping, and it will be difficult to make a clean, sharp thread, for the reception of the service-pipe.

There is no need that the street main should be excessively thick; nor on the other hand should it be too thin. For ordinary sizes I think three-eighth inch about the proper thickness. Large sizes should, of course, have a corresponding weight of metal.

Having settled the questions of size, thickness, and quality of his mains, the engineer will next look at the question of their proper location in the street.

The streets of a city having all the modern conveniences, will be occupied by gas mains, water mains and sewers, under ground, and by street railway tracks above ground; and in selecting the proper line for the gas pipe, it is important to consider its present and possible relationship to each, or all the above mentioned neighbors. It will generally be found, that the city authorities will insist, that the gas main shall yield precedence to the sewer, and also to the water main; if, as is usually the fact, the city owns the water works. I have often known a gas company to be compelled to take up and remove its mains, at a large expense, in order that a sewer or a water main might occupy its bed, not always because there was a real necessity for the change, but because the city authorities chose to have it so. If the order to budge comes. it is best to pick up and move, as resistance will be vain, and irritating to those who should be conciliated.

Now, in a growing town, if the gas engineer happens to be in advance of the city engineer, it is well to remember that the latter will soon be along, and, if possible, to anticipate his wishes. He will, usually, desire to locate his sewer in the center line of the street, and hence, I think it generally better to lay the gas main pretty near the one curb line or the other, hoping that the water main will be laid on the side of the sewer which the gas main does not occupy, and probably this will generally be the result. If the gas main be placed near the curb line it will be easily accessible, under most circumstances. If there be Nicholson or other wood pavement, the objection to disturbing it will be avoided, because the pipe may be reached by removing a small piece of the gutter pavement, which is usually of stone; or if it be of wood, the workmen can get down to the pipe without disturbing it seriously, or doing much damage. This is always important, for obvious reasons. Where the main lies on one side of the street, there is, indeed, a serious difficulty, when there is occasion to lay a service to the opposite side, especially in the case of wood pavement, unless, as in a few instances, where the ground is sandy, and the service pipe can be pushed through under the pavement; but in case of clay or gravel, or of any hard earth, there is no way but to take up the pavement and dig, except one, and that is to double pipe the street. Sometimes this is the better way, even if the obstacle just mentioned be not in the way. For example: A street is very wide: say 100 feet or wider; long services are liable to trap, and also to other obstructions. In such a case I prefer to lay two pipes, one near each curbstone. The extra expense is, in part, compensated in avoiding the necessity of laying long service pipe, if, as in most cases, the gas company furnishes the service from the main to the curbstone, without expense to the consumer. But the great advantage is this; with a short service there is almost always an uninterrupted flow of gas to the customer, and I regard this as of prime importance.

Having decided upon the line, or location of his pipe, the engineer will next consider the depth at which he should place it. There is one general rule to govern him, viz., *the main should be placed below frost*, that is, so deep, that no ordinary amount of cold will reach it. Every gas manager must be familiar with the evil effect of frost upon gas in a pipe. It depreciates its quality, and interrupts its flow. But, there are other evils attendant upon laying a main near the surface. If frost gets below the pipe, it may heave it, and thus disturb the joints. In case frost reaches a main in much force, the contraction, caused by it will be injurious to the joints, and it is said, that in some cases, pipe has been broken by contraction, caused by cold. When laid, the main should never be disturbed, by any influence. It should neither expand nor contract, and it should neither be lifted by frost, nor depressed by any force from above.

And this leads naturally, to a few words concerning the foundation upon which the pipe should rest. If the ground, at the bottom of the ditch, be solid, that is sufficient; but if it be soft, and liable to either sink or slide, means should be sought to obviate the liability to either. The judgement of the engineer will dictate what should be done, in any given case; but he should, by the use of some material, wood, brick or cement, secure a good bed for his main.

He must look carefully to his grade, and see, that at suitable points, he can secure a complete discharge into drip-boxes, of all condensation. The exact circumstances of each case will decide how often, and where he should place his drips.

Having settled all the foregoing matters, the actual laying of the pipe demands the most untiring supervision. Good joints are of the last importance. Good pipe, good location, good foundation, good grade—all these will not avail, unless good joints be secured. Why invest large sums in buildings, retorts, exhausters, condensers, scrubbers, purifiers and holders,

after good gas has been made, it is allowed to waste into the ground, while on its way to the consumer? I think almost any other error in our business, is more excusable than this; and yet, no doubt, this is the point at which a fair profit is wasted, annually, by many gas companies.

I am not competent to settle the mooted question, which is the better material for joints, cement or lead? My prejudices are in favor of lead. My company has tried both, and now uses only lead. Let each decide for himself, but be sure, that his joints are tight.

In laying pipe, my method of proceedure is this.

First. I provide the best soft pig lead. I never buy the hard, irregular, uncertain stuff, which is sold by the plumbers, because, though nominally cheaper, is really dearer than good lead, for good joints cannot be made with it every time.

Second. I provide a good quality of spun-yarn for gaskets; and to make sure, that I have such a quality, I have it manufactured to order.

Third. After the main has been placed, the workman drives into the space between the spigot and the socket, a gasket of the above mentioned spun-yarn. This must be thoroughly done.

Fourth. A mould of soft clay is placed about the pipe, near the socket, and melted lead is poured in to the mould, so that the space outside of, and next to the spun-yarn, is filled.

Finally. The lead is tamped, thoroughly, so as to completely fill the interstice about the spigot.

To make all perfectly sure, the pipe is tested, by etting in the gas, before covering, and if any leaks are discovered, the remedy is applied at once. Soon after the pipe is brought into use, the line is carefully inspected, and if any signs of imperfect joints are discovered, the pipe is uncovered, at the proper points and the defect cured.

I have described my own practice, not because I suppose it original, but because it is the best practice I know, and because it has worked well in my experience. It is offered for criticism, and I have to request, that any suggestions for its improvement may be freely offered.

Mr. Neal—I would ask the gentleman, in the first place, whether he ever has any breaks in his mains?

Mr. Price—We have had breaks sometimes in consequence of the digging of sewers, or some disturbance by the street authorities.

Mr. Neal—Breaks and leaks I suppose. Where do these breaks or leaks occur usually; in the joints or in the body of the pipe?

Mr. Price—The body of the pipe, from actual breaking.

Mr. Neal—Do the joints ever leak?

Mr. Price—Sometimes. If the pipe is disturbed so that it sinks, then there is danger that the joints will be opened so as to cause leakage.

Mr. Neal—I asked the question for this reason; I have not used lead for a great many years. I prefer cement. If there is any leakage or any breakage at all it occurs more frequently in the pipe at the bell than in any other part. I usually find the breaks just at the bell, where the pipe is attached.

Mr. Price—What causes it to break?

Mr. Neal—From depression—from digging underneath, or from other causes by which the pipe is disturbed.

Mr. Price—Is it ever caused from frost?

Mr. Neal—The joint does not give way unless it is improperly made, or bad cement is used.

Mr. Price—Our people hold that the lead joint is the best. They say that the gas pipes, where the cement joints have been used, have broken from contraction, or from some other cause. I don't know whether our people are justified in this opinion or not. They may have strong prejudices against cement. Some years ago they had some bad joints made, or the cement was not properly put in. If I understand it rightly the cement must be carefully made, and must be very carefully handled, and the joints must be very nicely put together, and must be made very quickly after the cement is prepared, in order to secure a good joint. I know that it did not work successfully with us. Whether the cement put in was bad, or the joints improperly made I don't know, but at any rate our people abandoned it after having given it a fair trial. It may be they did so without good reason. I know my people never use the cement. They use it about the works in making certain joints but not in street mains.

Mr. Neal—You spoke of the necessiry of laying mains of large size, in order that the distribution may be as even as possible throughout your district. I know this is true, and that it is a good plan. In taking up old pipes in the Charlestown district we replace them with larger ones than those that were laid at first. Is not the pressure greatest near the gas works, at the time of the greatest consumption? Is it not necessary to put on an inch more, or two inches more, unless your mains are very large at the further end of your district?

Mr. Price.—I suppose, of course, inevitably, that the pressure is a little heavier nearer the gas works. It depends upon the shape of the ground. If the works are very much below the plateau upon which the city stands, you require less pressure at the works.

In our case, the great body of our consumption is about three quarters of a mile from the works, and our works are from 30 to 40 feet below the plateau. At one time, we were obliged to raise the pressure to about 20 lines (tenths), in order to get 8 or 9 lines in remote districts. Of course some of our people did not get good light. We had too much pressure so that there would be blowing, and there would, of course, be excessive consumption where there was no carelessness whatever; and the fact was, that persons in one part of the town, were slaughtered for the sake of benefiting a remote district. It was a great mistake. We have corrected it since that time, and have now a very fine distribution. I have alluded to it, by way of illustration. It may be a very common mistake. It is a very bad one. There is nothing, I believe, to-day, that the gas companies can make a greater error in regard to, than to appear to rob people, to appear to force upon them more gas than they want, and more than they can use. We have hard work to keep in a moral position with the community. I hold that a gas company should be untiring in their efforts to remove every possible cause of irritation. There should be no just cause of complaint, so far as our dealings with the public are concerned.

Mr. Neal.—There is another matter connected with the laying of mains, which is interesting to us; and that is, that the mains should be tight. I would ask if there is any person in this hall who has no unaccounted-for gas. I say this, that sometimes the loss is apparent, and sometimes it may be very great, but I have an arrangement by which I can measure, on a pleasant day, all the gas that passes out, and that is used. A great deal of gas is used for domestic and manufacturing purposes during parts of the day. That gas is measured very accurately by the system which I have adopted. I take it by the hour, and multiply it by 24, and then multiply that result by 365, allowing a difference between the station meter and the meter at the works. Of course the amount produced is greater than the amount sent out. But this calculation that I have named, includes all that is lost by leakage or any other source, and all that is used. I multiply what is sent out in an hour by 24, and that by 365, and now what becomes of the loss?

Mr. Price.—You dont expect me to answer that question—Do you?

Mr. Neal.—I consider that this matter of leakage is a fallacy. There may be an apparent loss, but by examination and comparison, between the station meters and a meter on the outlet main at the works, and the amount of gas sent out, I think it will appear that the loss is more apparent than real.

Mr. Price.—I may be permitted to say that, in regard to Charlestown, it may be a fallacy to some extent. But one thing I am certain of is, it is not a fallacy, but is a lamentable fact in regard to a good many gas companies, that I have knowledge of. For instance, I know of some companies, who show a manufacture of 46,000,000, that have a loss of about 3,000,000, and I have no doubt that some companies lose very often, a fine profit by leakage. That is right where, in my judgement, a strict supervision is needed. I think that the laying of pipes is one o the most important matters connected with our business. I think it is one of the greatest mistakes that managers of gas works can make, to allow the pipes to be put into the ground by common laborers, and only visit the scene of operation three or four times in the course of the day. I wish to speak respectfully of all mankind, but I do say, "never trust a common laborer to lay your pipe." I dont know as you ought to trust anybody. There ought to be a constant and careful supervision of the men whom you employ to do the work. You should have a thoroughly active and energetic man, and we who understand the business thoroughly, to be constantly on hand, to see that the work is well performed. It is a great mistake, as I said before, to suppose that the work can be carefully supervised and properly done by an engineer or manager, visiting the place where the pipe is laid, once in five or six hours.

The Secretary—How deep do you lay your pipes at Cleveland?

Mr. Price—From four to five feet.

The Secretary—You have given us your ideas about the laying of mains, the making of joiuts, etc., and we may reasonably suppose that the present distribution of your gas is from a plant arranged and put down under your instructions, and in accordance with the views you have expressed in your paper, and in this discussion. May we inquire what the unaccounted for gas is now, as compared with the time when you had that high pressure?

Mr. Price—It has been very much reduced. Some eight or nine years ago the leakage was large. I have been connected with the company between nine and ten years in its management. Of course we consume a great deal more gas now than we did at first, and our percentage would naturally be smaller, if the amount remained the same. But the unaccounted-for gas has been very much diminished relatively to the amount produced. I don't take any credit for that myself. We have some very excellent directors, one particularly. In fact they are all excellent directors, but one of them is an eminently practical man, and a great deal of attention was given to that subject, and besides, we have a man who is thoroughly experienced in the work, and who is worth his weight in gold. He gives the most close and careful attention to it. Leakages have been sought for and ferreted out and corrected, and in laying all our new pipe, the utmost care has been taken to see that the work was thoroughly done. Our distribution is very perfect now. It is not perfect, but very nearly perfect, and it is so simple because so much care has been taken with a particular part of thebusiness.

Mr. Neal—That is another fallacy—I mean percentage. I ask a gentleman "What is your loss?" and he sighs and says "20 per cent." I ask another gentleman and he says "Ten." Perhaps the loss may be exactly the same in both cases.

Mr. Price—That is relatively, you mean?

Mr. Neal—Yes. Here is one making 100,000,000 a year, to suppose a case. There is a small hole or aperture through the pipe, by which 1,000,000 escapes. What is the per cent of loss? Another man makes 50,000,000, and has exactly the same kind of opening, and he loses 1,000,000. What is his loss?

Mr. Price—Of course his loss is a much larger per centage.

Mr. Neal—Now they speak of loss that it is so much per cent; that is not the fair thing. I should say that the proper way would be to state the amount the company has actually lost. I think that that would show the matter in its true light. One person says, "My loss amounted to so much. Another, "My loss amounts only to so much. Another says, "My loss is a great deal more than that." Whereas the one whose percentage is larger may actually lose less

Of course it is true that the company making the most gas can afford to lose, better than the company making a smaller quantity.

Mr. Littlehales—I have figured somewhat upon this question of leakage, and in my experience in this country I have found that the leakage amounts to 16.3 on the gas made. Taking it in a mile of main it came to 1390 feet for twenty-four hours. I compared that with another company whose leakage was 21.3, and their loss per mile of main pas 780 feet. So you see the loss in the larger company was nearly double the loss of the small one whose percentage was much higher.

Mr. Neal—Do you reduce your pipes to a given size?

Mr. Littlehales—No. I take simply a mile of main. Of course in the larger sizes there is so much more consumption; and I think it is fair to set one against the other. This percentage system is a bad one. It is a misleading one altogether. If we could arrive at some more satisfactory method of estimating the unaccounted-for gas, it would certainly be of great benefit to our companies. I think the proper way is to estimate the loss upon a mileage of main. There is another way in which a large amount of gas is lost. In laying new mains a great many companies use cotton waste, or something of that kind, as they go along. A great deal of gas is wasted in that way. Our system, when we start on a new section of main, is to bladder it off. We take an ordinary ox bladder and put it on the pipe, and let it remain there until we have finished our section of main, and then we take the bladder off again, and there is not a particle of gas lost. I think it is a good plan to adopt.

Mr. Cathels—There is one matter connected with the waste of gas that deserves some consideration, and one which perhaps some members of the Association have not thought of. It is a very usual thing now in cities, for protection against burglars, to leave one or more lights burning in the stores all night. It is a well known fact in a large establishment, where there is a fifty light dry meter, that in a majority of instances it is most unfortunately true that when these lights are turned down very low, the gas is not registered. There is just a sufficient film between the valves to allow the gas to pass through without being registered. I think that is the case with seventy per cent. of the dry meters of that size, when the lights in a store are turned down very low, as we see them at all times in the city. It may be a mistake, but I think if you take a dozen of 50-light meters promiscuously, that have been used in this way, and examine them, you will find that it is not a mistake. I don't say that is the fault of these who manufacture the meter. You may take as perfect a dry meter as can be turned out, and I think you will find that this is the case in almost every instance, when a 50-light meter is in use in a building where one or two lights are turned down very low, and kept burning all night. You will find that the gas is not properly condensed, and deprived of the ammoniacal liquor or vapors of tar, and the sliding valves become slightly coated, so that there is a sufficient film between them through which the gas can pass without being registered There is, unquestionably, a great deal of gas lost in this way, I do not say that this is the case in every instance. but I do think it is the case in a great many instances. As I said, there is a sufficient film or a sufficient space to allow the gas to pass. Now, with a wet meter this would not be the case. In a wet meter, if the water line is kept accurately, the gas cannot pass without being registered. If you have a thousand stores, each burning two or three lights for the whole night, and during the whole of Sunday, as is often the case, you will find it a very considerable item at the end of the year. And this is an element, of course, that goes into the estimate of unaccounted-for gas.

Mr. Neal—Would a 10-light meter operate in the same way?

Mr. Cathels—Of course, the larger the meter the more likely this is to occur.

Mr. Sherman—There is one subject to which I desire to call the attention of the Association. I think it is a most important one, and if I may be permitted I would like to offer a suggestion in regard to the best material to be used for joints. My own experience is decidedly against lead. I have never been able to keep my joints tight with that material. I think there is this to be said in favor of lead—in case there is cutting away beneath the pipes, of the earth in excav ting for sewers or water pipes, they will give, but if the joints are made of cement, you will have a broken pipe. I think it is better to have a few broken joints than to have a large extent of leakage, caused by a joint sinking. Now, in regard to the point made by Mr. Cathels, about the loss caused by under registration of meters, I do not go to the extent he does, but I have no doubt that there is a large loss to gas companies from that source. Most of our mer chants keep two small jets burning during the night, and, in my opinion, in most cases, we furnish that light without any expense to them.

Mr. Lindsley—I have some facts connected with the joints of pipes, that will apply to the subject under consideration. I had occasion to uncover a pipe which had been laid a number of years. I had occasion to do this when I first became connected with the gas company which is now under my charge. I uncovered the pipe that had been laid for some years, possibly it had been down three or four years, and I found a joint that had been made with lead, and made substantially in the way that Mr. Price has described, but with yarn in the socket a couple of inches, and an inch and a half of lead, but the lead was withdrawn from the socket in some instances. I speculated a little as to the cause of this condition of things, or theorized as you may say. I do not know whether it is correct or not, but my idea was in reference to it, that it was due to expansion and contraction of the pipe by the change in temperature during the seasons; that when the pipe was laid it was laid in warm weather, and the spigot ends were laid as close as they could be, and the cold weather contracted the pipe and it was withdrawn from the socket, and when the pipe expanded again with the warm weather, in the ensuing season the spigot came back. and the lead did not go back with it, and that thing occurred every year. I don't know whether I am right or not, but it is cerfainly the fact that the lead was withdrawn, in many instances, over an inch from the bowl of the pipe. We have in our practice made it a point to go over the mains with care at distances of some eight or ten or twelve feet, and apply a match. We find that this pays well and is worth the amount of trouble we take.

Mr. Wood (New Bedford).—I am willing to give my mite to this matter. The practice with us has been to use cement; we did formerly use lead but we found a great deal of trouble, in as much as the company who first started our works came from Philadelphia, where probably it was not necessary to lay pipe as deep, to gaurd against the frost, as it is with us. There was a great deal of contraction and expansion from changes of the season. We had considerable apparent loss, and I was suspicious of one particular street, where the pipe had been laid down, and the joints had been put in with lead. We examined it with care, as has been suggested by Mr. Lindsley. The pipe was about 1200 feet in length. There were flashes along almost the whole length of it, and upon taking up the joints and recaulking them, we diminished our waste 5000 feet a day at once, and there was not a joint, (not more than one) in the whole length of the pipe, that would light with a match. when we came to examine them, still there was a leakage. This was accomplished by just going over the length of the pipe, in the manner I have described. It was a three inch pipe.

The Secretary.—I would like to inquire as to the meter, and the outlet to the holder. Engineers tell me there is at least five per cent. loss somewhere by condensation, and I would like to know if any person present has ever tried any experiments in relation to it.

Mr. Littlehales.—In a great many cases, I have put the meter in the same room with the exhauster, and kept my meter at a high temperature, and I found that there was a very considerable difference. When you get over five degrees, it will make a difference of one per cent. in the registration; consequently, if you measure gas at a high tempereature, when it comes to the street main it shrinks. I think that will affect the unaccounted-for gas two or three per cent. Our works leaked considerably: we took each joint and caulked it, and we brought the leakage down to a very small amount, and we have never had any trouble since.

Mr. Sherman.—In regard to the caulking of joints, I will say that the company with which I am connected, reduced their leakage 20 per cent., by just going over the joints and caulking them.

Mr. Neal.—This subject I think, is pretty well exhausted, and I would like to say something in regard to the question of naphthaline. I have heard to-day, from one of the gentleman present, of a very simple remedy. It was so simple, that the gentleman who was speaking to me about it said, that he was afraid the Association would not think it worth considering, and for that reason he did not mention it. It is certainly very simple, and very economical; and I think it will do away with Farmer's Scrubber or the Coi Condenser, and the other experiments that have been employed to get rid of this trouble. It is this: A gentleman from Memphis stated to me, that they were at one time very much troubled with naphthaline, from some cause or other, and the superintendent thought he would experiment a little, and see if he could not get rid of it. So he mixed saw-dust with his lime, (two parts of lime and one of saw-dust) that is, one-third saw-dust and two-thirds lime. This he put in his purifiers, and then turned on the gas; and the naphthaline passed away entirely, and he has never had any trouble since.

The President.—Is the Executive Committee ready to make a report on the next place of meeting?

The Secretary.—Mr. President: The Executive Committee after the adjournment last evening, met and considered the subject where the next place of meeting should be, and finally resolved to recommend that the next annual meeting of the Association be held at Cincinnati. That is the recommendation which the Executive Committee make. On motion the recommendation was adopted.

The Executive Committee also took into consideration, the subject of printing the proceedings of the Association, and finally resolved that it would advise that it should be done, and that it be supervised by a committee consisting of the President and Secretary, and Mr. William Henry White, with the understanding that a part of the proceedings of the past session, and possibly this present one, might be eliminated, and still leave the subject matter discussed clearly stated, and that all superfluous matter should be striken out for the purpose of saving expense, and also saving the time of the reader, whenever he should have occasion to investigate any subject.

Mr. Wood (Syracuse)—I do not believe in restricting the printing of these reports for publication. I think it should be in such shape that we can have the whole thing before us at all times for reference. It was suggested yesterday that these proceedings were printed in the Gas-Light Journal, and that there was no necessity of publishing them in pamphlet form. Every member wants the report of these proceedings, in a permanent form, for his library for reference; being printed in the Gas-Light Journal, they are not convenient to be bound for library form. The matters discussed here are certainly very important, and I do not think they should be restricted in any way, or that the Executive Committee should be empowered to curtail the reports at all, but to print them in full as they are given here. I, therefore, move to amend the recommendation proposed by the Executive Committee, to the extent that the proceedings shall be printed in full, in pamphlet form, and a suitable number of copies be furnished each member.

A member—I will explain to the Association the object of the recommendation of the committee. It was

simply for the reason that there might be some conversstion, and some things said here which it might not be well to place in permanent form. It was merely to exercise their judgment, and not print a lot of extraneous matter, such as conversation upon immaterial matters, which would burden the record, and be a matter of a good deal of expense, without adding anything to the value of the report. The ides was that the subject should be left to the discretion of a number of gentlemen who would see to it that nothing was omitted which was of importance, and nothing put in which was not of importance; but, if the motion for the amendment prevails, then this committee will have no power to strike out anything, but all that is said here must be published in full. They will have no discretion in regard to striking out superfluous matter, but will have to put everything in.

Mr. Price—I hope the amendment will not prevail. There certainly should be some discretion exercised in regard to the matter that is published; and while I have no fault whatever to find with the reports which have been made heretofore of the meetings of this Association, yet I think a good many interlocutory remarks that are made here, which sound very pleasant at the time, but which are certainly no addition to the report, and which do not read well when they are published, should not be printed as the records of this Association. As the reports have heretofore been made, every jocular remark that was made, and every little question that was asked, has been faithfully recorded. I think the record should be carefully revised and approved by a committee of gentlemen who are thoroughly qualified to do the work. Let the substantial matters which are discussed here be put in; every substantial question that is asked, and every substantial answer that is given, upon questions of interest and importance to the Association, but all the superfluous talk which is indulged in by the members in the course of the proceedings, I hope will be stricken out.

Mr. Wood (Syracuse).—The report of the meetings that have been held, as reported by the stenographer, have not been of the class that the gentleman has just referred to. I dont think that any question of so trivial a nature as he has suggested, will find its way into the body of the report. My idea was that the report should embody everything that transpired here, and should be a faithful record of our proceedings. For instance Mr. Neal, of Charlestown, has just made a statement in regard to saw-dust being mixed with lime as a preventative of naphthaline. Such a suggestion as that is certainly worthy of a place in our reports. It may have a very important bearing upon the question, so much so that it may be found necessary to appoint a special committee to investigate the matter, or, at any rate, sufficiently important to warrant attention being bestowed upon it. So I would have the report as full and general as it can be made, leaving out, of course, all trival matter.

Mr. Wood (New Bedford).—I think there is less difference amonst us than would at first appear. I think if this committee are judicious in their cutting down, that it will be satisfactory to all concerned. I hope there will be nothing left out: but for one I am quite willing that they should exercise their judgement as to what shall appear in the report, and what shall be omitted. All that has been said, that is to the point, I hope will be put in.

The question was then put upon the amendment of Mr. Wood, of Syracuse, and it was lost. The question then recurred upon the original recommendation which was carried.

[To be continued.]

A new alloy for bell metal is proposed, which does not tarnish, is less liable to crack, gives a better sound, and is much lighter in weight than the allow usually employed for the purpose. It is prepared as follows: Nickel 1 lb, and copper 6 lbs. are melted and cooled. Add zinc 1 lb., aluminum ½ oz. Melt and cool. Melt again, and finally add ½ oz. quicksilver and 6 lbs. melted copper.—*Ironmonger.*

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 227.

* A Graduating Thesis at the Stevens Institute of Technology.

We have become acquainted with the duty of the hydraulic seal and have learned its merits; we now come to a very important topic which should be considered in this connection; we here have reference to the

PRESSURE ON THE RETORTS.

This is generally due to the hydraulic seal alone, but in many cases it is necessary to add a pressure in the hydraulic main. The following is a *resume* of a series of experiments which were made in 1875, at the Boston Gas Works, for the purpose of determining the effect of the seal on the yield of gas. When the pressure on the retort was evenly kept at ¼″ of water, the results when working on a small seal do not differ much from those obtained when the gas is passed to the hydraulic main free of seal: the illuminating power in the latter case was a trifle higher, but the yield was slightly lower. If, on the other hand, the seal is increased to ¾″, there generally seems to be a decrease both in quantity and in quality of the gas.

The presence of this pressure has the additional disadvantage, perhaps even more serious than the one just mentioned, of being the chief source to which must be attributed the

CARBON DEPOSITS

on the interior surface of the retorts. It is true, dialysis has frequently been designated as the cause of these incrustations, while many attribute them to the high heats which it is necessary to carry; it is quite generally admitted, however, that they are mainly due to the pressure, and some years ago experiments were made in England by Grafton, which seem to prove this very conclusively. These carbon deposits are, however, beneficial in one respect; when the retort is being used for the first time the leakage through its numerous pores is very great. These are gradually filled up by the carbon and the retort becomes practically gas-tight; it assumes a metallic character and hardness, and its strength and durability are largely increased. In the course of time, however, these deposits become so unmanageably great as to require serious attention. The back pressure on the retorts which causes these incrustations, is mainly due, as we have seen, to the seal, and consequently numerous attempts have been and are being made to do away with the seal while the retort is in action, and of introducing it again when it is "off." Most of the devices in this direction, however, have completely failed, from the fact that they are too complicated to be readily repaired, while the valves, rods, and stuffing-boxes which they all involved, were liable to trouble by "sticking." At the Pittsburgh Gas Works, a very simple device to this effect is said to give entire satisfaction.

If these carbon deposits could conveniently be kept within proper limits, not only could the quantity and quality of the gas be increased, but the consumption of fuel could be largely reduced, from the fact that the carbon is an excellent non-conductor of heat.

The introduction of one of the above devices is always a matter of some expense; in most cases a great deal of responsibility is thrown upon the attendants; for these reasons most gas managers prefer to remove the superfluous carbon whenever a sufficient quantity has accumulated. By the method which was formerly resorted to, the deposit was removed by chipping it out; the retorts, however, were so seriously damaged that this practice was soon abandoned. An air-blast was then used, but it had this great objection, viz.—that it did the work too thoroughly, since it removed the carbon from the body of the retort. Another plan, and one which is still largely used, was then resorted to; in this, a simple, natural draught is used instead of the forced draught; a clay pipe, 3″ in diameter, is introduced, passing through a lid on the mouthpiece, and the "bonnet" on top of the standpipe is removed. This process, though thorough, is very slow, and requires too many retorts to be out of service at any one time. The method which is now almost universally used is due to Geo. W. Edge, Esq., of Jersey City. In this the general arrangement adopted in burning out by means of the natural draught is preserved, but is strengthened by a steam jet in the end of the 3″ carbon-pipe; the rush of steam through this induces a current of air which is just o the requisite strength. The retort should be at the ordinary working heat, and the steam in a very dry, superheated state. In several works which use this method it was found of the greatest advantage to burn out each retort every 30 days, when the operation need not require more than one or two hours at most.

GENERAL RETORT HOUSE ARRANGEMENTS.

The daily work of one retort has previously been set down at 6,000 cubic feet, of 16·5 candle gas; in order, therefore, to meet the given maximum daily demand, it would be necessary to have from 80 to 84 retorts in use, or say, 14 benches. We would make an allowance for a few reserve benches, and for those which are being repaired, although this is usually done in the summer months when the demand is smallest; besides these, a few retorts would temporarily be out of service while being repaired and burnt out. The number of benches of six retorts in the projected works is 18, placed back to back, in two sets of nine, and each having its own hydraulic main, 12″ mains and connections. The four 12″ mains will connect with two 16″ inch mains, one of which will be in service at any one time. It might be proper to state here that the general "station connections" in the projected works will be 16″ in diameter; these, it is true, might be made to pass 1,000,000 feet if necessary, but as there would hardly be a good reason for saving in this place, the 16″ connection was adopted, particularly since such is considered a good practice.

The retort houses will be a plain and substantial brick structure, 105 feet in length and 60 feet in width, thus giving the men ample room in manipulating their charging scoops, rakes and barrows. Nothing but iron and slate should enter into the construction of the roof. Great care should be taken to secure a thorough ventilation of the retort-house; for this reason a number of large windows should be provided, furnished with adjustable wrought iron blinds; the doors should be arranged, if possible, to the same end but without causing an injurious draught; finally, an ample ventilator should be provided in the roof. The foundations of the retort-house proper do not require any special notice, since they do not differ from those which are ordinarily adopted for buildings of this size; much attention, however, should be devoted to the construction of the foundations for the benches. If it is intended to build in ordinary soil, a brick foundation, resting on a thick bed of concrete, will be quite sufficient; in "made" or marshy ground, on the other hand, it would be necessary to resort to a system of filing. Thus, in our case, it would be found expedient to drive two rows of piles, 12″ in diameter and 2′ 6″ from center to center, under each of the several walls, the intervening space being filled in with concrete; they are capped with suitable timber or what is better still, with heavy stone, since the heat from the bench has been found to penetrate the foundation to a considerable depth; the bench proper is supported by means of an ordinary red-brick circular arch resting upon these copping pieces. Radiation of heat in this direction is intercepted by occasional air spaces throughout the foundation. Retort-houses are sometimes built on what is known as the "stage system", in which a cellar is provided under the charging floor. The coke, on being drawn, falls through the floor and into a wagon in which it is quenched before being removed. Among the advantages which are claimed for this system are, the greater convenience in drawing the charge since the coke

THE AMERICAN GAS LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

This is a recognized official organ of—
IGHT, HEAT, MINING INTERESTS, STEAM, WATER-SUPPLY, PATENTED INVENTIONS, VENTILATION, SANITARY IMPOVEMENT, AND GENERAL CHEMICAL SCIENCE.

TERMS

UBSCRIPTION—Three Dollars per annum, in advance.

AGENTS

NEW YORK—AMERICAN NEWS COMPANY, 119 and 121 Nassau St
OSTON—S. M. PETTENGILL & Co., 6 State Street.
HILADELPHIA—COX, WETHERILL & Co., Ledger Buildings, Phila.
Germany—B. WESTERMANN & Co., of New York.

THURSDAY, DECEMBER 2, 1876.

does not interfere with the operations of the stockers; the greater comfort for the men; the coke can be handled with greater economy and, finally, the fact that the coke-yard may partially be done away with, since the cellar affords extra storage. The two great disadvantages which are connected with the stage system are, in the first place, the greater cost of the retort house, because of the necessarily heavier and deeper foundations and of the iron charging floor and, secondly, that it is very difficult to ventilate a cellar of this kind in a thorough manner. It is evident, therefore that the advantages, themselves not very important, are generally so nearly balanced by its disadvantages that only when local circumstances—a very limited amount of real estate, for instance,—demand it the stage system is at all applicable. In England it is quite general only at the works in London and its vicinity; in the United States but few examples of this system exist—the retort-houses of the Metropolitan Works in New York, of the Brooklyn in Brooklyn, N. Y., of the Laclede in St. Louis, Mo., and of the new works at Pittsburgh, Pa., being, it is believed only ones which are built according to it. In the case of the last mentioned works, the stage system has enabled Mr. Farmer to make the arrangements for handling the coke very complete; they were called for by the fact that, since the coke is there in great demand, it requires to be handled with economy and dispatch.

It is necessary to touch upon the subject of chimneys *versus* short flues before leaving the retort-house. The former only are in use in England while with us short flues are the rule, the only example of chimneys in this vicinity being at the Nassau Gas Works. The flues are usually carried up about four feet above the top of the bench, discharging the products of combustion from the furnaces directly into the retort houses. A number of merits are claimed for the short flue, among others that a leak in the retorts is readily and at once detected by the presence of a long, luminous flame; that they serve to create an upward current of air, which carries the gases from the mouths of the retorts, while drawing and charging, up into the ventilator; that this system is less expensive than the other, since no heavy formations are required, the flues being directly built upon the brickwork of the benches. With some kinds of fuel this system would, of course, be found impracticable; but there is no difficulty whatever with coke, since the draught which they can give, is more than sufficient. On the other hand, the advocates of the chimney system in the ordinary sense of the word, urge that the short flue should be discarded for sanitary, if for no other reasons.

[To be continued.]

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

Naphthaline.

KNOXVILLE, TENN., Nov. 21st, 1876.

Mr. Editor: In connection with the discussion on naphthaline, as reported in your last issue, the following extract from the chemistry of gas-lighting will not be out of place.

The author, after speaking of the serious loss and inconveniences which arise from *not* retaining a portion of the ammonia in the gas, says, on page 40—"nor is this loss the only drawback; for it would appear that, as naphthaline possesses, like resin, electro negative properties, it is also, like resin, a feebly acidulous power. This, indeed, is perhaps better demonstrated by the fact that, with sulphuric acid, it forms an acid, and not a neutral combination called the sulphonaphthalic acid.

"Consequently, it might, *a priori*, be inferred that the presence of ammonia in coal gas would tend to retain in suspension the naphthaline, or, in technical phrase, to prevent its deposition in the mains. And this is actually found to be the fact in practice; for coal gas, from which all the ammonia has been taken away, is singularly prone to deposit naphthaline in the mains and pipes through which it passes."

Now, will not this fact explain somewhat the seemingly eccentric behavior of naphthaline, its appearing and disappearing from no conceivable cause. Any engineer troubled with naphthaline could soon ascertain if the undue absence of ammonia was the cause of it, for it is an easy matter to retain at least a portion of ammonia in the gas. The results of the experiment would be interesting.

Yours, respectfully,
JAS. H. SOMERVILLE, Supt.

Lubricants.

It is perhaps difficult to assign any correct reason why certain substances are in their nature better lubricants than others. Many theories have been promulgated, without definite proof of the same, and as yet are mere speculations, beyond the ability of any to demonstrate their correctness. This is especially true of those theories founded on supposed variation of molecular shape. One theorist argues that the molecule of the perfect fluid lubricant is perfectly round, hence its own freedom of motion, while, he says, the imperfect lubricating fluid has its molecules spheroidal in shape or flattened at the poles. Another suggests that the latter are void, and consequently wanting in that free movement peculiar to the true sphere. Some of this may or may not be true. The difficulty of proving or disproving it lies in our inabiliy to determine the size or shape of a molecule by any means in our power. The most powerful microscope fails utterly to show them, and should some material for lenses be discovered infinitely superior to glass or other material at present in use, we should fall far short of appreciating a molecule through the vision.

In has been estimated that in one-thousandth of a cubic inch of horn, a piece not much, if any, longer than a grain of ordinary gunpowder, there are seventy-one trillions of molecules of albumen, and even the molecules of this complex substance are infinitely larger than the simpler hydro-carbons, and it is hardly necessary to say that they, by their extreme minuteness, are far removed from any possibility of human vision, and as has been said by eminent scientific authority, "light is too coarse a medium to enable them to be seen, if we could add sufficiently to the powers of our microscopes." It will not do, therefore, for a manufacturer to claim that the superiority of his process produces molecules of a certain shape, and *ergo* his oil is the best.

Some theorists have compared the action of lubricants to that of shot interposed between two moving surfaces. This, of course, is suggested of spherical particles able to keep their shape under the necessarily great compression. This analogy holds good so far as one layer of shot is concerned; but let several layers of shot be placed one on top of another, and they manifestly fail to move among themselves, and consequently cannot aid in moving anything else, and if we imagine the molecules of the lubricant similarly placed, as we must do (considering that in the slightest film of oil there must be thousands, perhaps millions, of molecules piled up, as it were, even under the greatest compression), we cannot accept the shot analogy as a good illustration.

But the whole theory of atoms and molecules is beyond the conception of most minds, and to reason from atomic composition or molecular arrangement to account for the ability of certain substances to lessen or overcome friction is to get beyond our depth. Perhaps in good time a Tyndall, or Thomson, or Joule, or Morton, or their successors in original investigation, will determine the question for us, why water or a solution of dextrine does not lubricate as well as sperm oil.—*Iron.*

Health of Watering-Places.

At the Brighton Congress of the Social Science Association last year, a resolution was passed recommending the Council of the Association to suggest to the local sanitary authorities of watering-places the desirability of establishing a system by means of which owners of lodging-houses and hotels should be enabled to have their premises inspected, and certified if found in a generally healthy condition with reference to drainage and other sanitary arrangements. The Council solicited the views of the local authorities on the subject, and received a number of answers in reply, which have been considered, and on which is founded the following report:—

"(*a*).—That it is desirable that the system, in the first instance, should be a voluntary one. and that otwners of lodging-houses and hotels should be invited by the sanitary authority of the town to apply to he medical officers of health to certify that the drainage and other sanitary arrangements of the respective houses or hotels are satisfactory, and generally that the same are in a healthy, habitable condition.

(*b*).—That these certificates be renewed every three months, or more often if the sanitary authority think it desirable, but that it shall be the duty of the medical officer of health between the renewals of his certificate to visit the premises so certified as occasion may require, in order to ascertain that the same remain in the sanitary condition to which the certificate applies.

(*c*).—That a minimum charge, at the discretion of the sanitary authority, shall be made for the issue of such certificates.

(*d*).—That a register shall be kept at the town-hall, or other public office, of the certified houses and hotels, open to inspection without charge during usual office hours; and that local authorities should exercise their best efforts, by advertisement or otherwise, to inform the public of the regulations herein suggested.

(*e*).—That the owners of the certified hotels and lodging-houses should be required to produce the certificate when called upon, and should exhibit the same in some conspicuous part of the house, and that this should be a condition of registration."

The report has been forwarded to the local authorities of the several watering-places and health resorts in England and Wales.—*The Builder.*

Channel Passage.

The commissioners appointed by the English and French Governments respectively have submitted to the two Governments a memorandum which they recommend should be adopted as the basis of the proposed treaty between Great Britain and France with regard to the Channel Tunnel and Railway. It provides for the conclusion within five years from the 2nd August last, of an agreement between the French and English companies for the construction and working of the submarine railway, including the tunnel.

An international commission of directors is to be appointed by the two governments. The concession for the submarine railway will be for ninety-nine years from the opening, at the end of which period the undertaking will be handed over to the respective Governments. The works of exploration are to be commenced within one year from July 1, 1876, and with in five years the companies are to declare whether they propose to retain or abandon the concession. After the end of thirty years the two Governments are to have the right of purchasing the undertaking. With regard to the working of the railway, it is proposed that each Government shall have the right to suspend the working of the Submarine Railway and the passage through the tunnel whenever it shall, in the interests of its own country, think necessary to do so. And each Government shall have the power to damage or destroy the works of the tunnel or submarine railway, or any part of them, in its own territory, and also to flood the tunnel with water. Works for purposes of defence, and such other works as may be required by either Government, shall be executed by each company in accordance with the laws for the time being in force in the country where the company is established. It is understood, as regards the use of the submarine railway, that equal facilities shall be afforded in the formation of trains, in the running of carriages and wagons, and in the transport of passengers, animals, and goods of every description, whatever may be the points of departure or of destination, and whatever may be the routes followed. —*Jour. Society of Arts.*

Dangers of Breathing by the Mouth.

Dr. Guye, in the London *Medical Record*, directs attention to the evils of breathing by the mouth. To appreciate these it must be remembered that the functions of the nose in respiration are threefold.

1. The olfactory sense secures it against the entrance of impure air.

2. The moisture of the nasal passages gives a certain degree of aqueous saturation to the inspired air, the contact of which is thus rendered less irritating to the mucous membrane of the throat and larynx.

3. The inequalities of the organ retain solid particles suspended in the air, which is proved by the quantity of dust sometimes found accumulated in the nostrils. These functions are all lost in breathing by the mouth. Further, the contact of dry air soon produces circulatory troubles in the pharyngeal region, and even an habitual catarrh, susceptible of easy transmission by continuity to the eustacian tube and cavity of the tympanum. Granular adenoid pharyngitis often has this origin. Niemeyer believied that attacks of pseudo-croup in children have their origin in dryness of the glottis produced by oral respiration. To enable the patient to breathe through the nose we must restore the nose to its proper condition, and then in children stop the mouth by an impervious respirator. Many cases of catarrhal deafness were cured in this way alone.

The Channel Tunnel.

The British Society of Engineers publishes the following details of the preliminary works for the tunnel under the channel:

The year 1875 was profitably employed. The out lay amounted to 61,000 francs, the half of which, or 30,500 francs, had been expended in geological researches at the end of December, as shown in the report presented at the first general meeting on the 15th of March, 1875, by M. Lavalley. The result of the first year's labors is contained in four reports, which were then distributed, and which describe the bases on which the studies are founded. This year the surveys have continued on a larger scale. In 1875, 1523 soundings were taken, of which 753 brought up specimens from the bottom of the sea. The engineers had at their service the Pearl, a small steam tug with insufficient appliances, and with which they worked between August 10 and September 21, during which time they could only leave the port of Boulogne 20 times. This year the soundings have been effected on the English side with a large vessel fitted with a crane and better provided. The work commenced at the beginning of July, and the vessel is stationed at Dover, which port it can enter or leave at all hours. Greater progress in the formation of the company has, however, been made in Frrnce than in England. The 2,000,000 francs required for the preliminary surveys have not yet been raised.

Oils and Fat Destructive to Iron.—At a meeting of the Industrial Association of Moravia, help at Brunn, M. G. Ruekensteiner commented on the destructive influence of pure animal and vegetable fats upon steam engines and boilers. These bodies are decomposed by the action of high pressure steam, and fatty acids (such as the margaric, stearic, oleic, &c.) are set at liberty, and attack the iron, as he has demonstrated in a series of experiments. He therefore recommends, as the only means of preserving machinery, the use of such mineral oils as boil at high temperatures, whereby wear and tear of machinery and the consumption of grease are reduced. Mineral oils do not contain fatty acids, are incapable of being decomposed, and do not form insoluble soaps. If they become mixed with boiler incrustation they diminish its tendency to cling to the sides of the boiler, and thus exert in this respect also a benefical action. —*Ironmonger.*

Gas Stocks.

Quotations by W. R. Scott & Co., Bankers,

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December 2, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Harlem	$1,850,000	50	105	110
Manhattan	4,000,000	50	238	245
Metropolitan	2,500,000	100	140	145
" Scrip	$1,000,000	...	102	—
" Bonds..	500,000	1000	104	—
Mutual	5,000,000	100	100	102
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	137	142
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	182
Citizens	1,200,000	20	93	95
" Scrip	320,000	1000	95	97½
Peoples	1,000,000	10	45	50
" Bonds	$ 325,000	...	---	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	70	75
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	135	140
" Scrip		...	98	100
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	--	90
Baltimore, Md	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	—
" " Ctfs.	53,000	—	--	—
" " Bds.	124,000	—	—	--
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	132	—
Fort Wayne, Ind		100	...	---
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	152	—
Hempstead, L.	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
Bonds	30,000		90	
Paclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	125	135
Leoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	—	100
Stillwater, Minn	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Saugerties, N. Y	15,000	100	110	115
Troy, Citizens	600,000	100	—	100
Central, Westchester	466,000	50		95

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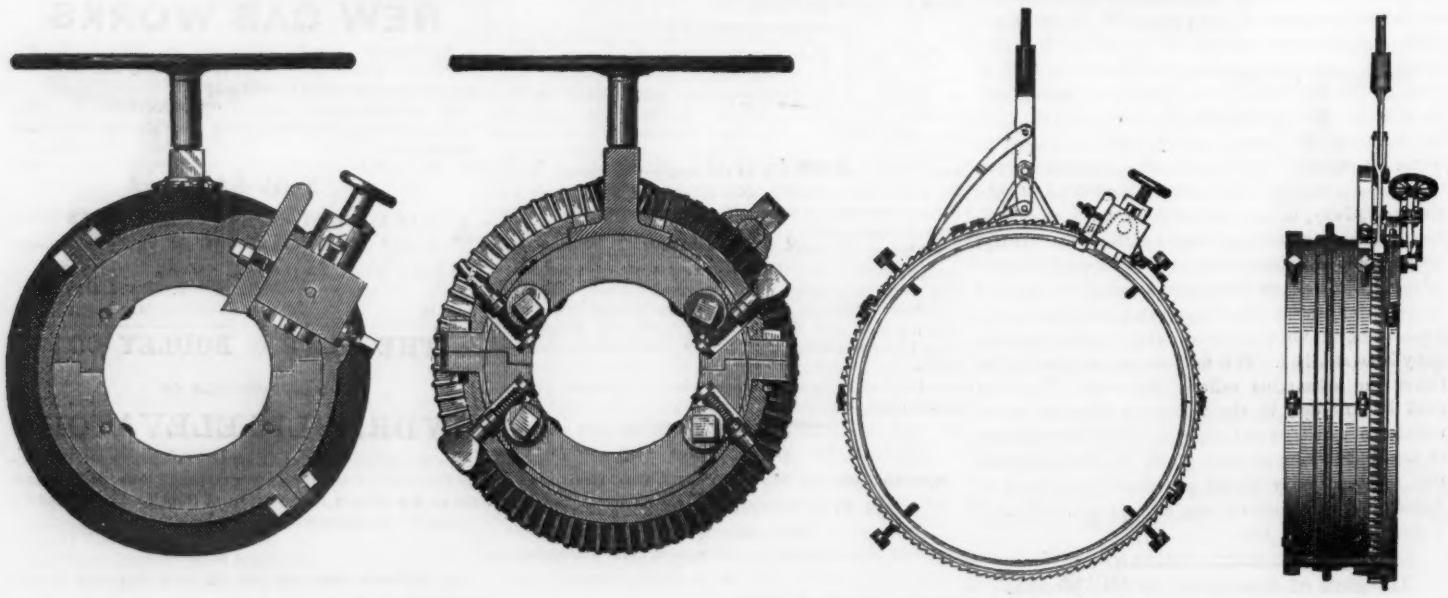

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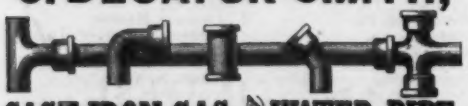

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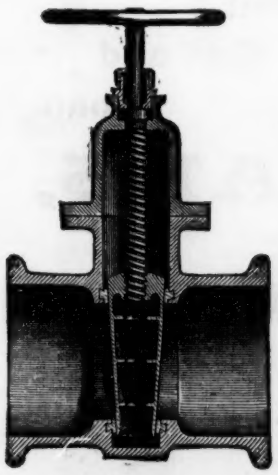

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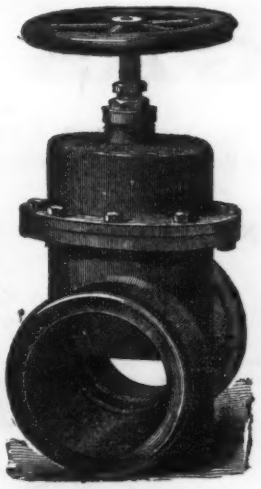

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Gas Coals—Perkins & Job, 27 South st., N. Y.
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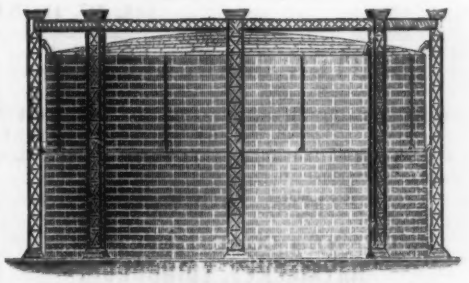

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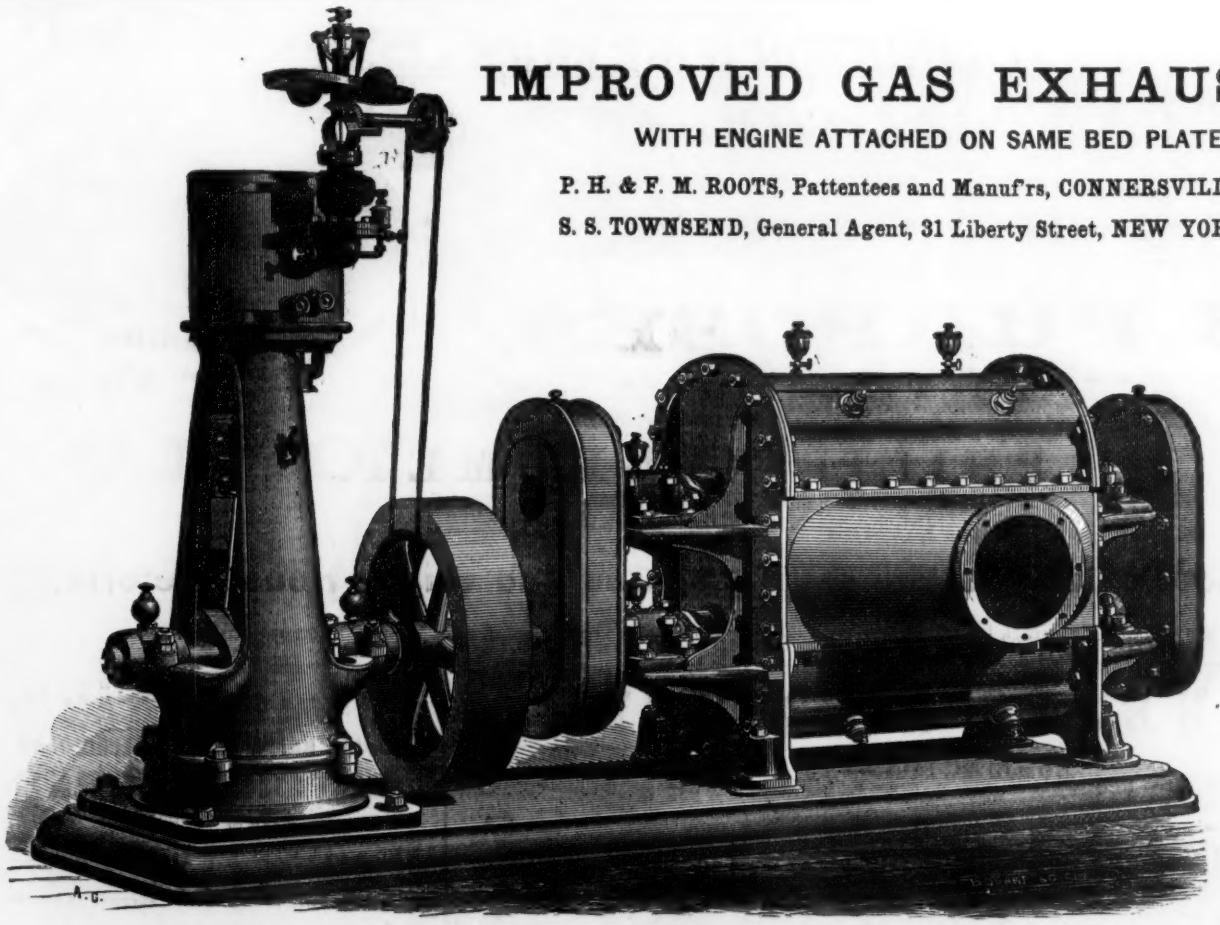

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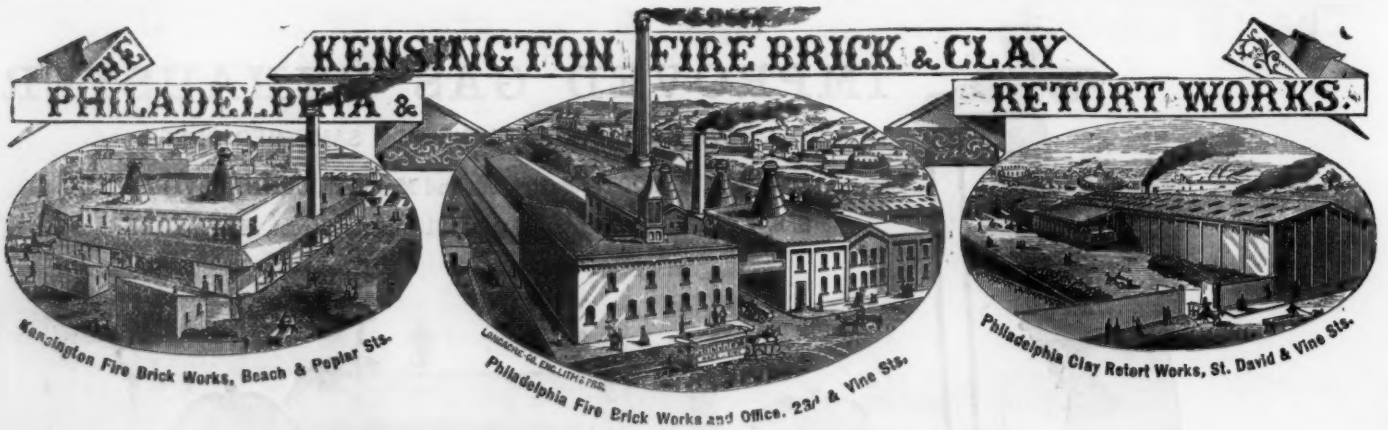
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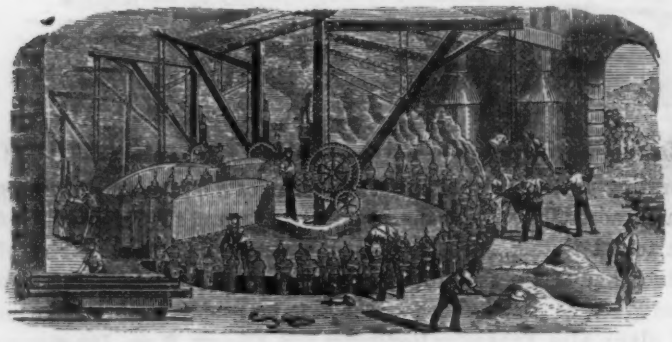

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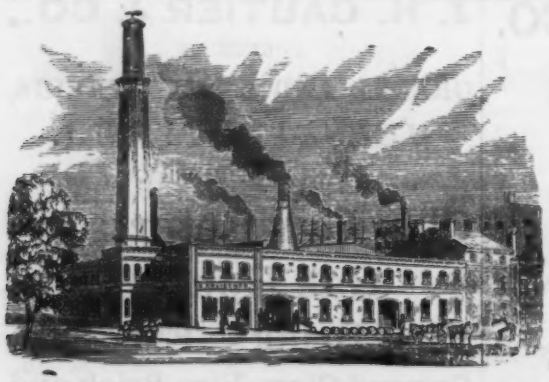

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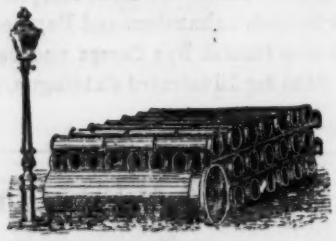

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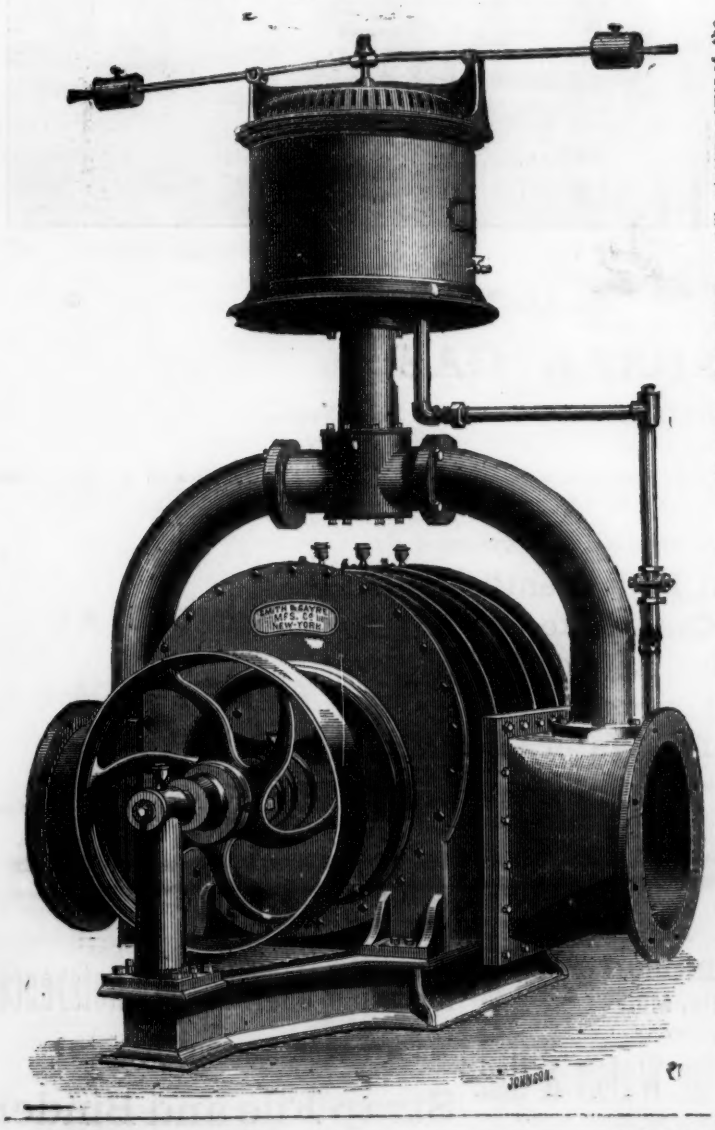

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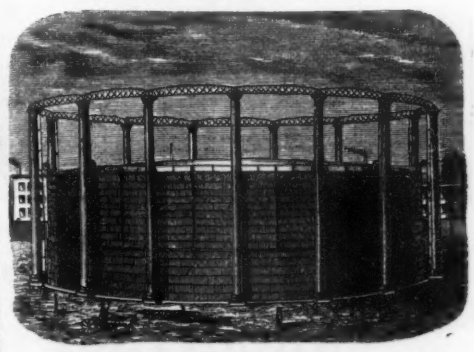

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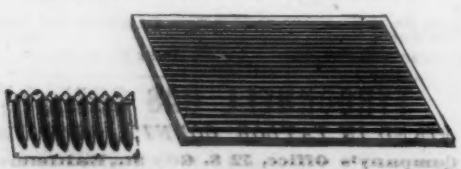

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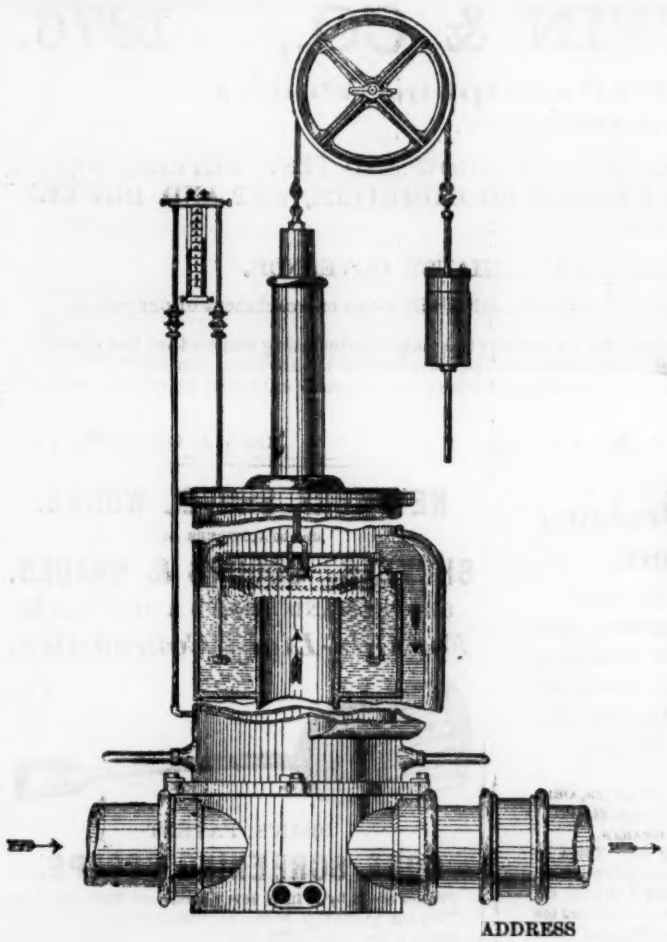

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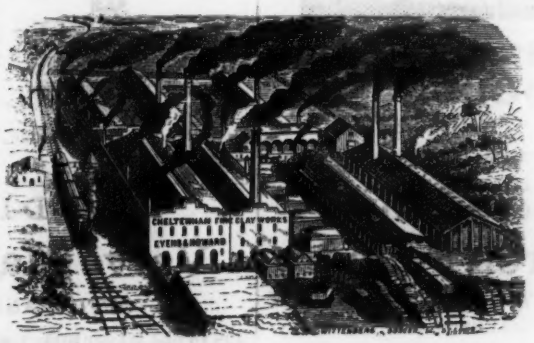

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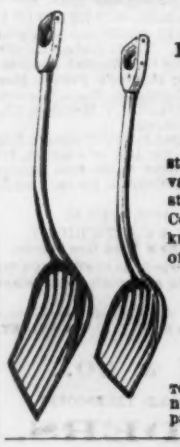

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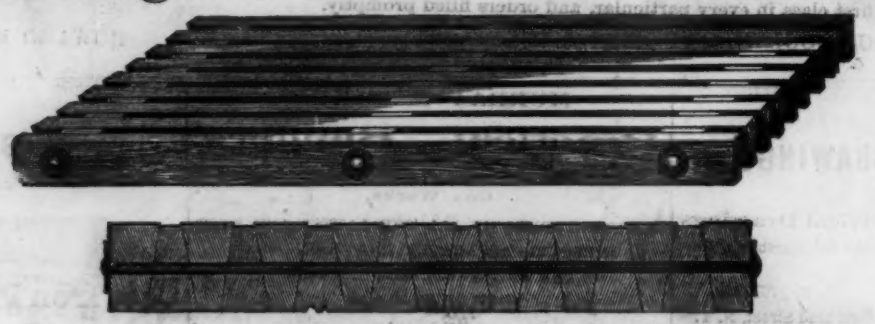

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